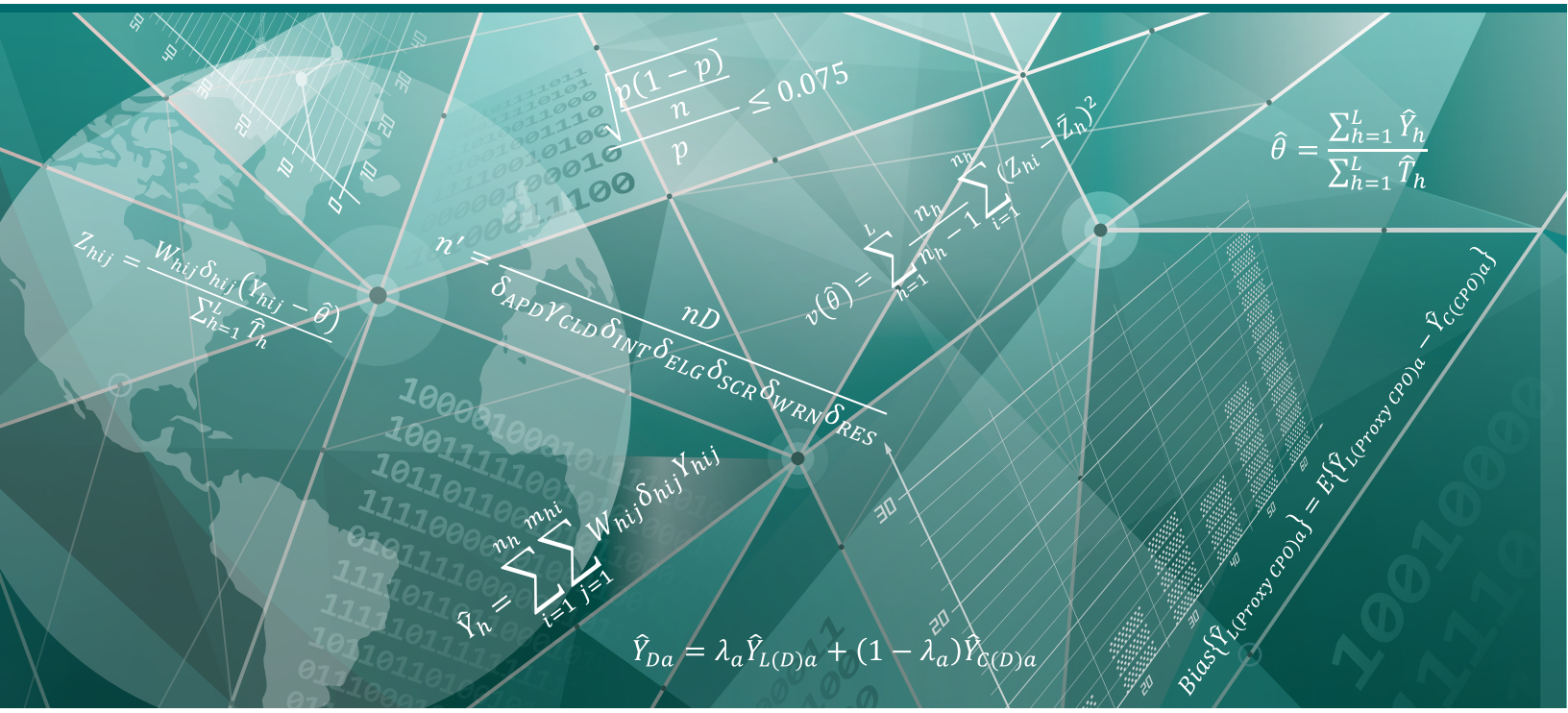
NATIONAL CENTER FOR HEALTH STATISTICS

Vital and Health Statistics

Series 2, Number 180

June 2018



Issues in Developing Multidimensional Indices of State-level Health Inequalities: National Health Interview Survey, 2013–2015

Data Evaluation and Methods Research

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

Suggested citation

Talih M, Villarroel MA. Issues in developing multidimensional indices of state-level health inequalities: National Health Interview Survey, 2013–2015. National Center for Health Statistics. Vital Health Stat 2(180). 2018.

Library of Congress Cataloging-in-Publication Data

Names: National Center for Health Statistics (U.S.), issuing body.
Title: Issues in developing multidimensional indices of state-level health inequalities : National Health Interview Survey, 2013-2015.
Other titles: DHHS publication ; no. 2018-1380. 0276-4733 | Vital and health statistics. Series 2, Data evaluation and methods research ; no 180.
Description: Hyattsville, Maryland : U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, 2018. | Series: DHHS pub ; number 2018-1380 | Series: Vital and health statistics, series 2. Data evaluation and methods research ; number 180 | "June 2018." | Includes bibliographical references.
Identifiers: LCCN 2018022888 | ISBN 0840606915 (pbk.)
Subjects: | MESH: Health Status Disparities | Research Design | Health Status Indicators | Evaluation Studies as Topic | United States
Classification: LCC RA408.5 | NLM W2 A N148vb no.180 2018 | DDC 614.4/2--dc23 LC record available at https://lccn.loc.gov/2018022888

For sale by the U.S. Government Printing Office
Superintendent of Documents
Mail Stop: SSOP
Washington, DC 20402–9328
Printed on acid-free paper.

NATIONAL CENTER FOR HEALTH STATISTICS
Vital and Health Statistics

Series 2, Number 180 June 2018

Issues in Developing Multidimensional Indices of State-level Health Inequalities: National Health Interview Survey, 2013–2015

Data From the National Health Interview Survey

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

Hyattsville, Maryland
June 2018
DHHS Publication No. 2018–1380

National Center for Health Statistics

Charles J. Rothwell, M.S., M.B.A., *Director*

Jennifer H. Madans, Ph.D., *Associate Director for Science*

Office of Analysis and Epidemiology

Irma E. Arispe, Ph.D., *Director*

Makram Talih, Ph.D., *Associate Director for Science*

Division of Health Interview Statistics

Stephen J. Blumberg, Ph.D., *Director*

Robin A. Cohen, Ph.D., *Acting Associate Director for Science*

Contents

Text Figures

Detailed Tables

Contents—Con.

Appendix Table

Acknowledgments

The authors gratefully acknowledge the thorough reading of this report by Amy M. Branum; technical input from Frances A. McCarty and Van L. Parsons; and constructive comments from Irma E. Arispe, Stephen J. Blumberg, Ernest Moy, and Anjel Vahratian.

Issues in Developing Multidimensional Indices of State-level Health Inequalities: National Health Interview Survey, 2013–2015

by Makram Talih, Ph.D., Office of Analysis and Epidemiology, and Maria A. Villarroel, Ph.D., Division of Health Interview Statistics

Abstract

Objectives

To describe methodological issues that arise in the construction and design-based estimation of multidimensional indices that aggregate state-specific inequalities in core health measures, using data from the National Health Interview Survey (NHIS).

Methods

For each state, an overall, multidimensional health inequalities index was computed from NHIS 2013–2015 by aggregating summary indices of inequalities—by sex, race and Hispanic origin, education, urbanicity, and disability status—in healthy behaviors (HBs), access to medical care (AMC), general physical health status and mental health (PMH), and absence of multiple chronic conditions (MCCs) among adults aged 45–64. Because the choice of summary index impacts the magnitude and relative ranking of state-specific overall indices, two index classes were studied: the Gastwirth (G) and Atkinson (A_α) index classes. Bootstrapped confidence intervals for point estimates and most likely ranks for rank estimates were calculated. Due to data limitations, only the 20 most populous states were analyzed.

Findings

HBs had lower prevalence than AMC, PMH, and absence of MCCs in the U.S. population; accordingly, HBs contributed more to the state-specific overall inequalities indices than the other three measures. Rankings differed between G and A_α indices, and by whether A_α indices were adjusted to account for the health of the least healthy subgroups. Yet the majority of the 20 states were ranked in consistent tiers by these index classes. Multidimensional inequalities indices aggregate only inequalities, regardless of population levels for the core health measures selected. As a result, states were not well differentiated based on these indices alone, increasing ranking uncertainty.

Summary

This report highlights issues that arise when developing and estimating state-specific multidimensional health inequalities indices using national survey data. Selected results from the analysis emphasize the importance of measure and index selection and illustrate sources of ranking uncertainty.

Keywords: demographic and socioeconomic inequalities in health • state health metrics • composite index • health rankings • NHIS

Introduction

Multidimensional Indices of Health Inequalities

In Healthy People 2020 (HP2020), summary measures of health inequalities by various population attributes (e.g., sex, race and ethnicity, income, education, disability status, and geographic location) track the nation's progress toward the HP2020 overarching goal to "achieve health equity, eliminate disparities, and improve the health of all groups." Such summary health inequalities measures quantify health inequalities between subgroups defined by any given population attribute in any one of more than 600 measurable, population-based HP2020 objectives. For example, for objectives expressed in terms of adverse outcomes to be reduced, the HP2020 summary rate ratio is an average of the rate ratios of each subgroup's rate relative to the least adverse subgroup rate for a given population attribute. Summary measures also track changes in health inequalities over time (1–3).

The numerous summary health inequalities measures in HP2020 track inequalities disparately for each selected population attribute and health indicator. Aggregating these summary measures into a smaller set of indices can offer a high-level view of the state of inequalities in the health

of the nation. In this report, two types of aggregate health inequalities measures are presented. *Composite health inequalities indices* are formed by aggregating the summary indices of inequalities in a given health measure (e.g., access to medical care) over multiple population attributes (e.g., sex, race and ethnicity, education, disability status, and geographic location). *Overall health inequalities indices* are formed by aggregating composite health inequalities indices over multiple health measures (e.g., healthy behaviors, access to medical care, general physical health status and mental health, and absence of multiple chronic conditions). Insofar as the selected health measures span multiple dimensions of health, such overall health inequalities indices are said to be *multidimensional*.

Multidimensional inequality indices originate in the study of social welfare economics (4–6). In public health, inequalities in selected measures of health can be aggregated to monitor the reduction of U.S. health inequalities at the subnational level and to allow for meaningful comparisons and scorecards. Asada et al. (7) used a single measure of health—functional limitation—and aggregated inequalities by income, education, sex, and race and ethnicity, to form state-specific composite inequalities indices. In a subsequent publication, Asada et al. (8) used four health measures—poor or fair health, poor physical health days, poor mental health days, and low birthweight—and aggregated inequalities by education, sex, and race and ethnicity, to form county-specific overall inequalities indices.

This report's principal objective is to discuss some of the methodological issues that arise in the development and design-based estimation of state-specific overall health inequalities indices. The National Health Interview Survey (NHIS) was selected as the source of the state-level data used in this report because NHIS is one of the major data collection programs of the National Center for Health Statistics (NCHS) (9) and is the leading national data source for HP2020, providing tracking data for 1 in 10 HP2020 objectives (10). NHIS offers a broad, consistent framework for estimating selected health measures both nationally and at the state level for the most populous states.

Using NHIS data, four core measures of health were constructed for this report to discuss the methodology: healthy behaviors, access to medical care, general physical health status and mental health, and absence of multiple chronic conditions. Health inequalities in these measures can be assessed across subgroups defined by any number of population attributes. In this report, five such attributes were selected: sex, race and Hispanic origin, educational attainment, urbanicity, and disability status.

A corollary to developing state-specific overall health inequalities indices is that states can be ranked according to those indices. Such rankings can highlight successes and challenges that inform public health policy and bolster stakeholder collaboration toward achieving national health goals (11). This report shows how to quantify the rank uncertainty that is due to how little or how well multidimensional inequalities indices differentiate between states, and to complex survey design and sampling variability.

General Methodological Issues

Constructed with input from, and debate among, multiple stakeholders, multidimensional indices are powerful tools for analyses and international comparisons of health and human development. For example, the Human Development Index (HDI), used by the United Nations Development Program (UNDP) for cross-country comparisons, is an average of three basic measures of human development: educational attainment, decent living standard, and longevity (12). Another UNDP index, the Multidimensional Poverty Index, is composed of 10 indicators that span three dimensions of poverty and relate to the United Nations' Millennium Development Goals, namely health (measured using indicators of nutrition and child mortality), education (measured using years of schooling and school attendance), and living standard (cooking fuel; sanitation, water, electricity; floor; and assets) (13). In the United States, broad, foundational measures of health are indicators for monitoring progress toward HP2020 goals (14,15), and HP2020 leading health indicators communicate high-priority health issues (16,17). However, aggregate (also known as composite) measures were suggested to enhance understanding of overarching public health developments (18) and to provide a succinct, high-level overview of subnational variations in health, such as by state (11,19) or county (20).

The major strength of multidimensional indices is that the information they provide supplements the information that the component indicators can offer separately, because they help identify population subgroups that bear a joint burden on more than one of the component measures (12). One point of contention with multidimensional indices is that they are highly dependent on the weighting scheme selected for aggregating the component indicators—so much so that their construction can prove to be as much of an art as it is a science (21–24). Another point is that changes in a multidimensional index over time may reflect changes in any or all of the indicators further down in the hierarchy, so that drilling down to the components is often necessary to properly interpret changes at the top.

This report brings to light additional methodological challenges that emerge specifically when developing multidimensional indices of *health inequalities* For example, if an *a priori* rationale for doing otherwise is lacking, equal weights can be given to the population attributes used, the subgroups defined by each population attribute, and the inequalities in the health measures selected. However, a different weighting scheme (for example, one that is based on a consensus derived from an expert panel and evidence-based scientific research) could lead to different substantive findings and state rankings.

Methods

Data

Study sample

Data for the analysis in this report are from the 2013–2015 NHIS for adults aged 45–64. Response rates for sample adults in the 2013–2015 NHIS ranged from 55.2% to 61.2% (9). For this report, combining data years 2013–2015 provided statistically reliable estimates in the 20 most populous states for a sufficient number of the health measures and population subgroups considered. The 20 most populous states for which state-level estimates are presented are Arizona, California, Florida, Georgia, Illinois, Indiana, Maryland, Massachusetts, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Texas, Virginia, Washington, and Wisconsin.

Data source and survey design

NHIS is a cross-sectional multipurpose health survey that has monitored the health of the nation since 1957 and has tracked health indicators, health care access, and health-related behaviors for the U.S. resident civilian noninstitutionalized population (9). Interviews are conducted in person in respondents' homes, but follow-ups to complete interviews may be conducted over the telephone.

The NHIS sample design is redesigned after every decennial census. The sample design for the 2013–2015 NHIS data used in this report was implemented in 2006, and 2015 was the final year of that design's implementation. In the 2006–2015 design, around 87,500 persons (in 35,000 households) were interviewed each year, although sample size varied from year to year.

The 2006–2015 questionnaire consisted of: a Family Core component, with questions pertaining to all family members; a Sample Adult component, with questions pertaining to one randomly selected adult per family; and a Sample Child component, with questions pertaining to one randomly selected child per family (if children were present). Black, Hispanic, and Asian persons were targeted for oversampling to improve the reliability of estimates for these population subgroups.

The NHIS sample is drawn from each state and the District of Columbia and involves a multistage stratified sampling plan (25). The first stage of sampling is the selection of primary sampling units (PSUs) within each state. PSUs are counties or groups of contiguous counties.

For the 2006–2015 NHIS, after PSUs were selected, U.S. Census 2000-defined blocks within them were stratified by the 2000 census minority concentration status for implementing differential sampling rates for different subgroups, although these rates varied by survey year. PSUs very rarely straddled state boundaries. The resulting state stratification enhanced the survey's ability to provide reliable state-level estimates for the largest states. As a result, selected estimates for many states may be obtained by combining data years (25).

Statistical reliability and variance estimation

Statistical reliability was evaluated using new NCHS standards for the presentation of percentages (26). The new standards use the width of the Korn–Graubard modification of the Clopper–Pearson confidence interval, among other statistical criteria, to determine if the estimated percentage is reliable. When available, information about statistical reliability is provided in the table footnotes.

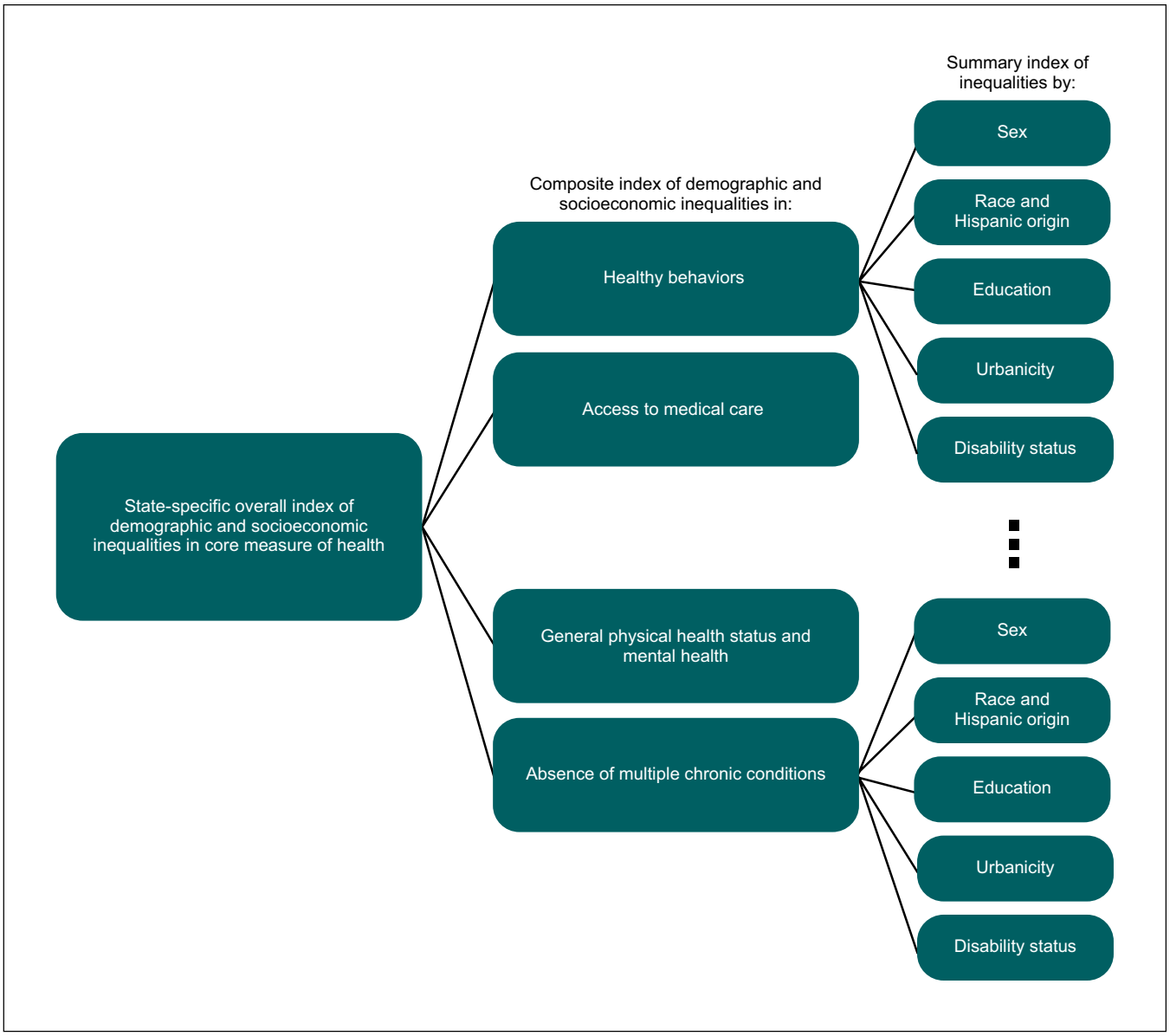
Variance estimation information, namely the pseudostrata and pseudo-PSUs, can be accessed from the public-use microdata files to allow data users to compute direct estimates of sampling errors that are consistent with the NHIS design (25). The pseudostrata and pseudo-PSUs also can be used to construct bootstrapped confidence intervals for point estimates and most likely ranks for rank estimates; see "Sampling variability of ranks."

Restricted use variables

Data for the analysis in this report are from the Family Core and Sample Adult components of the survey and are almost entirely contained in the public-use files. However, variables that could permit direct or indirect identification of survey participants are withheld from NHIS public-use files. Because this report required the identification of sample adults' state and county of residence, these variables required the use of restricted NHIS files. Restricted NHIS data are available to the public through the NCHS Research Data Center; see https://www.cdc.gov/rdc/index.htm. All findings were reviewed for disclosure risk prior to publication.

Construction of Multidimensional Indices of State-level Health Inequalities

The overall, multidimensional health inequalities indices were built in three stages (Figure 1). The initial building blocks were the state-specific summary inequalities indices corresponding to the demographic and socioeconomic attributes selected for the analysis. In this case, five attributes are used: sex, race and Hispanic origin, education, urbanicity, and disability status. At this initial stage, the summary indices were constructed for each population attribute separately for each of the health measures selected. Four health measures are used: healthy behaviors, access to medical care, general physical health status and mental health, and absence of multiple chronic conditions. As a result, the initial stage of the construction, represented by the branching segments of the flowchart in Figure 1, consisted of 20 summary indices (5 population attributes times 4 health measures) that summarize or aggregate several pairwise inequalities or differences between the subgroups defined by each population attribute for each health measure. These



SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Figure 1. Construction of overall index of health inequalities for each selected state from four composite indices of demographic and socioeconomic health inequalities that combine five summary indices of health inequalities each

summary indices had yet to be combined or aggregated across attributes or health measures.

At the second stage, the state-specific summary inequalities indices were aggregated over the population attributes to form a composite index of inequalities in each of the health measures. In Figure 1, four composite indices are shown, one for each of the core health measures selected for analysis.

At the third stage, the composite inequalities indices were aggregated, in turn, to form the overall, multidimensional inequalities index for each state. A description of the index construction at each stage and the selection of population attributes and core health measures follow.

Weights and relative contributions of summary and composite inequalities indices

Lacking an *a priori* rationale for prioritizing (reduction in) inequalities by one of these population attributes over the other four, equal weights were used for each of the five summary indices in constructing the composite inequalities indices. Similarly, lacking an *a priori* rationale for prioritizing (reduction in) inequalities in any one of the core health measures over the other three, equal weights were used for each of the four composite indices in constructing the overall index. See "Aggregating summary and composite inequalities indices" for additional details.

To quantify how inequalities by each population attribute would contribute to a given composite index, the hypothesis

that all five summary indices contribute equally (20%) was tested at the 0.05 significance level. Similarly, to quantify how inequalities in each of the core measures would contribute to the overall index, the hypothesis that all four composite indices contribute equally (25%) was tested.

Several options were available for constructing the 20 summary indices shown in Figure 1. Because the choice of summary index impacts the magnitude and relative ranking of the state-specific overall indices, two summary index classes were studied: the Gastwirth and Atkinson classes (see "Selection of summary health inequalities indices"). This report refers to the overall and composite indices that result from aggregating the Gastwirth summary indices as the overall and composite Gastwirth indices. Similarly, the overall and composite indices that result from aggregating the Atkinson summary indices are referred to as the overall and composite Atkinson indices.

Selection of population attributes

Analysts may wish to examine core measures of health among population subgroups that are defined through commonly used demographic and socioeconomic characteristics, such as in HP2020 (3,10). In this report, the following five attributes were selected to illustrate the methodology: sex, race and Hispanic origin, educational attainment, urbanicity, and disability status.

Sex

Sex was categorized as male and female. Sex of the sample adult was reported by a knowledgeable adult member of the household during the household rostering portion of the NHIS interview, and it was verified with the sample adult when the household respondent was other than the sample adult (27).

Race and Hispanic origin

Four categories of race and Hispanic origin were used in the analysis: Hispanic, non-Hispanic white, non-Hispanic black, and non-Hispanic person of other race(s), including multiple races. Race and Hispanic origin of the sample adult were collected during the household rostering portion of the NHIS interview.

Educational attainment

Four categories of educational attainment were used: less than a high school education, high school graduate or GED, some college education, and college graduate or above. Educational attainment of the sample adult was reported by the family survey respondent.

Urbanicity

Households' counties were classified using the 2013 NCHS urban–rural classification scheme (28). Three broad categories were considered in the analysis: 1) counties that were part of large metropolitan statistical areas (MSAs, having populations of 1 million or more); 2) counties in medium-sized MSAs (with populations of 250,000–999,999); and 3) counties in small MSAs (with populations less than 250,000) and in micropolitan statistical areas (with urban cluster populations of 10,000–49,999), and noncore counties. Urbanicity was coded from the NHIS restricted-use data files based on the county where the interviewed household was located.

Disability status

Disability status was determined by "yes" answer(s) to any of the following six questions, referred to as the American Community Survey (ACS) questions, which had been endorsed by the U.S. Department of Health and Human Services (HHS) as the standard set of disability questions for inclusion on all HHS national surveys (29):

- Person is deaf or has serious difficulty hearing.
- Person is blind or has serious difficulty seeing even when wearing glasses.
- Person has serious difficulty concentrating, remembering, or making decisions, because of a physical, mental, or emotional condition.
- Person has serious difficulty walking or climbing stairs.
- Person has difficulty dressing or bathing.
- Person has difficulty doing errands alone such as visiting a doctor's office or shopping, because of a physical, mental, or emotional condition.

The ACS questions were answered by an adult in families randomly selected to receive the Family Disability section of the questionnaire. About one-half of respondents from the person file were selected to receive the questions in the Family Disability section (30).

Selection of core health measures

NHIS provides data to track the health of Americans for multiple health measures, including health indicators, health care access, and health-related behaviors. Four core health measures were constructed for this report to represent the broad scope and depth of NHIS and illustrate the methodology: healthy behaviors, access to medical care, general physical health status and mental health, and absence of multiple chronic conditions. These core health measures are consistent with prior health measurement frameworks (11,18,20). For example, the Appendix provides a crosswalk between these NHIS-sourced core health measures and the measures identified in the Institute of Medicine's (IoM) *Vital Signs: Core Metrics for Health and Health Care Progress* (18). In addition, percentages of U.S. adults aged 45–64 meeting the selected criteria for these four core health measures by the specified demographic and socioeconomic attributes are shown in Supplemental Table I–5.

Healthy behaviors

Smoking, excessive alcohol use (including binge drinking and heavy drinking), and physical inactivity are U.S. public health priorities (31–36). NHIS questions about sample adults' smoking and drinking behaviors and levels of physical activity were selected for this report to construct a multipronged NHIS-sourced core measure of healthy behavior.

No smoking. Sample adults were first asked, "Have you smoked at least 100 cigarettes in your entire life?" Respondents answering "yes" were then asked, "Do you now smoke cigarettes every day, some days, or not at all?" Sample adults answering that they had smoked at least 100 cigarettes in their lifetime but currently did not smoke at all, and those answering that they had never smoked more than 100 cigarettes in their lifetime, were identified as meeting the "no smoking" criterion.

No heavy alcohol use. Heavy alcohol use was derived from three survey questions: "In your entire life, have you had at least 12 drinks of any type of alcoholic beverage?" "In any one year, have you had at least 12 drinks of any type of alcoholic beverage?" and "In the past year, how often did you drink any type of alcoholic beverage?" Heavy drinker was defined as a current heavy drinker ("yes" responses to the first two questions, and either 15 or more drinks per week for males or 8 or more drinks per week for females in the past year, on average), consistent with federal guidelines (37). Sample adults who reported drinking fewer than 15 drinks per week for males or fewer than 8 drinks per week for females in the past year, no alcohol consumption in the past year, or never having had 12 or more alcoholic drinks in their lifetime were identified as meeting the "no heavy alcohol use" criterion.

Physical activity. Federal guidelines recommend that adults perform at least 150 minutes (2 hours, 30 minutes) a week of moderate-intensity or 75 minutes (1 hour, 15 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination (38). The guidelines also recommend that adults perform muscle-strengthening activities of moderate or high intensity involving all major muscle groups on 2 or more days a week. NHIS questions ask about frequency and duration of light- to moderate-intensity and vigorous-intensity leisure-time physical activities, and frequency of leisure-time strengthening activities. Sample adults who met the recommended guidelines for both aerobic physical activity and muscle strengthening were identified as meeting the physical activity criterion.

Those who were nonsmokers, nonheavy drinkers, and physically active were identified as meeting the selected criteria for healthy behavior.

In the 2013–2015 NHIS, approximately 1.8% of all sample adults—and 2.1% of those aged 45–64—reported that they were unable to engage at least in moderate physical activity (as indicated by a response "unable to do this type of activity" to the NHIS questions about engaging in vigorous and moderate physical activity). For those adults, the NHIS-sourced core measure of healthy behavior used in this report was constructed only from the "no smoking" and "no heavy alcohol use" criteria.

See Supplemental Tables I–1a through I–1e for the percentages of adults aged 45–64 who met the selected criteria for healthy behavior in the 20 most populous states by each of the five population attributes (sex, race and Hispanic origin, educational attainment, urbanicity, and disability status).

Access to medical care

HP2020 considers that "access to comprehensive, quality health care services is important for the achievement of health equity" (39). An NHIS-sourced core measure of access to medical care was constructed from three selected criteria for access to care that were derived from several NHIS questions.

Having a usual place of care. Criterion was based on a positive response to the survey question: "Is there a place that you usually go to when you are sick or need advice about your health?" Adults whose place of usual care was the hospital emergency room were considered not to have had a usual place of care.

No unmet medical care need due to cost. Criterion was based on negative responses to all of the following eight questions asked in the Sample Adult and Family Core components of the survey: "During the past 12 months, was there any time when you needed any of the following, but didn't get it because you couldn't afford it?" 1) "Prescription medicines," 2) "Mental health care or counseling," 3) "Dental care," 4) "Eye glasses," 5) "See a specialist," or 6) "Follow-up care;" 7) "During the past 12 months, has medical care been delayed for {person} because of worry about the cost? (Do not include dental care);" and 8) "During the past 12 months, was there any time when {person} needed medical care, but did not get it because {person} couldn't afford it?"

Not experiencing delay in medical care. Criterion was based on negative responses to all of the following five questions: "There are many reasons people delay getting medical care. Have you delayed getting care for any of the following reasons in the past 12 months?" 1) "You couldn't get through on the telephone;" 2) "You couldn't get an appointment soon enough;" 3) "Once you get there, you have to wait too long to see the doctor;" 4) "The clinic/doctor's office wasn't open when you could get there;" or 5) "You didn't have transportation."

A sample adult who met all three of the above criteria was classified as meeting the selected criteria for access to medical care.

See Supplemental Tables I–2a through I–2e for the percentages of adults aged 45–64 who met the selected criteria for access to medical care in the 20 most populous

states by each of the five population attributes (sex, race and Hispanic origin, educational attainment, urbanicity, and disability status).

Health insurance coverage is correlated with the three selected criteria for access to medical care. Adults with health insurance coverage for more than 1 year are more likely to have a usual place of medical care and less likely to report unmet medical needs due to cost than those without health insurance (40). Differences in health insurance coverage by state (41) and race and ethnicity (42) also may affect health care access and utilization. For these reasons, health insurance coverage was omitted from the NHIS-sourced core measure of access to medical care used in this report, consistent with IoM's *Vital Signs* (18), where unmet care need is listed as a "core measure" of care access, whereas usual source of care and delay of needed care are listed as "related priority measures" (see Appendix).

General physical health status and mental health

Self-assessed physical and mental health statuses are indicators of perceived disease burden and quality of life that allow for broad comparisons across population subgroups (14,43). An NHIS-sourced core measure of general physical health status and mental health was constructed from NHIS questions about a sample adult's general physical health status and mental health.

General physical health status. Having good or better general physical health status was based on the responses "excellent," "very good," or "good" provided by the family survey respondent to the question, "Would you say {person's} health in general is excellent, very good, good, fair, or poor?"

Mental health. For this report, mental health was assessed using the Kessler 6 (K6) scale, which helps classify nonspecific psychological distress (NSPD), when present, as serious, moderate, or mild. The K6 scale is constructed from six survey questions: "During the past 30 days, how often did you feel" 1) "So sad that nothing could cheer you up," 2) "Nervous," 3) "Restless or fidgety," 4) "Hopeless," 5) "That everything was an effort," or 6) "Worthless." Responses to each of these six questions are scored as: 0 = none; 1 = a little; 2 = some; 3 = most; or 4 = all of the time. The six scores are summed for a total K6 score ranging from 0 to 24. A K6 score of 13–24 (serious NSPD) indicates a high probability of serious mental illness with serious impairment in functioning (44,45). A K6 score of 8–12 (mild to moderate NSPD) also indicates a high probability of a mental illness as defined by the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM–IV), but accompanying difficulties in functioning are less severe. A K6 score of 0–7 indicates either absence of or less than mild NSPD.

A sample adult who was reported to be in good or better general physical health and who did not report serious, moderate, or mild NSPD was classified as meeting the selected criteria for general physical health status and mental health.

See Supplemental Tables I–3a through I–3e for the percentages of adults aged 45–64 who met the selected criteria for general physical health status and mental health in the 20 most populous states by each of the five population attributes.

Absence of multiple chronic conditions

In 2010, HHS unveiled a strategic framework to improve health and quality of life for persons living with multiple chronic conditions (46). Ten of the 20 conditions prioritized in the HHS framework were reported in NHIS (47). NHIS questions asked if the sample adult had ever been diagnosed with:

- Arthritis, including rheumatoid arthritis, gout, lupus, or fibromyalgia
- Cancer, excluding skin nonmelanoma cases
- Chronic obstructive pulmonary disease (COPD)
- Coronary heart disease
- Diabetes, excluding gestational diabetes
- Emphysema
- Hepatitis B
- Hypertension
- Stroke

NHIS questions also asked if sample adults had a current diagnosis of asthma, as well as if, in the past 12 months, they had been diagnosed with chronic bronchitis or weak or failing kidneys (excluding kidney stones, bladder infections, or incontinence). For this report, NHIS sample adults with COPD, emphysema, or chronic bronchitis were considered to have COPD.

A sample adult met the "no multiple chronic conditions" criterion if they were reported to have ever been diagnosed with no more than one of the above 10 chronic conditions (including asthma and weak or failing kidneys, and with the COPD, emphysema, and chronic bronchitis diagnoses combined).

See Supplemental Tables I–4a through I–4e for the percentages of adults aged 45–64 who met the selected criteria for absence of multiple chronic conditions in the 20 most populous states by each of the five population attributes.

Selection of summary health inequalities indices

This section describes the construction of indices that summarize pairwise inequalities in each selected core health measure among the population subgroups that are defined by each specified population attribute.

For this report, two different summary index classes were used, the Gastwirth and the Atkinson index classes. Other commonly used summary index classes, such as the general entropy class as well as the class of so-called health concentration indices, also are available to analysts to use

instead of (or in addition to) the Gastwirth and Atkinson index classes (48–52). This report illustrates the impact of index class selection on the magnitude and relative ranking of the state-specific overall indices using just the Gastwirth and Atkinson classes; the latter is a broad class of indices that is mathematically related to both the general entropy class and health concentration indices.

Gastwirth summary index

The Gastwirth summary index looks at the difference between the average proportion for the outcome of interest and the most favorable group proportion (within the given population attribute) for that outcome (7,8). For a favorable health outcome (e.g., meeting the selected criteria for healthy behaviors, access to medical care, general physical health status and mental health, or absence of multiple chronic conditions), the most favorable group proportion is the highest proportion among the population subgroups of interest. Thus, the emphasis is on what it would "cost" to bring all worse-off groups to achieve parity with the most favorable group proportion (48).

The *absolute* Gastwirth index, *U*, can be written as:

$$U = \sum f_j \times (p_{\max} - p_j) = p_{\max} - p_{\text{tot}}$$

The *relative* Gastwirth index, *G*, which is unit-free, is given by:

$$G = \frac{U}{p_{\text{tot}}} = \frac{p_{\max}}{p_{\text{tot}}} - 1$$

In these equations, $p_{\max}$ is the most favorable group proportion, the p_j are the proportions for each population subgroup j, the f_j are the subgroups' relative sizes in the population, and p_{tot} is a weighted arithmetic average of the subgroup proportions:

$$p_{\text{tot}} = \sum f_j \times p_j$$

When the f_j sum to one, p_{tot} is the proportion for the total population. If some survey respondents have missing information about population subgroup membership, the weighted average p_{tot} is no longer the proportion for the total population. In those cases, the f_j are divided by the sum of the subgroup proportions in order to sum to one.

For each of the health measures and population attributes selected for this report, Supplemental Tables I–1a through I–4e display the most favorable and average subgroup proportions $p_{\max}$ and p_{tot} by state.

The indices *U* and *G* benefit from a useful practical feature: Even if any of the less healthy groups, with proportions $p_j < p_{\max}$, are aggregated, *U* and *G* remain unchanged, because both $p_{\max}$ and p_{tot} remain the same. Thus, while aggregation may improve the stability of subgroup estimates for smaller, less healthy groups (e.g., minority groups), aggregation will not affect the two Gastwirth indices or their stability.

Despite the practicality and simplicity of the Gastwirth indices, analysts need to acknowledge drawbacks when using these summary measures. First, indices *U* and *G* decrease if the healthiest group is combined with any of the less healthy groups, because $p_{\max}$ would decrease while p_{tot} would remain the same and $p_{\text{tot}} \leq p_{\max}$. Thus, if $p_{\max}$ is achieved by a small minority group and is statistically unreliable, but that subgroup is aggregated with another subgroup to improve reliability of the combined estimate, then the two Gastwirth indices will be impacted. In those cases, the Gastwirth indices prior to aggregation will be more conservative than the Gastwirth indices after aggregation: The gap between the worse-off groups and the heathiest group will appear larger before than after aggregation.

A second drawback is that the two Gastwirth indices may not reflect differences in the population composition of the states being compared. Suppose the population is composed of only two groups, with proportions $p_1 < p_2$. Because $f_2 = 1 - f_1$, increasing the relative size (f_1) of the less healthy group (e.g., a minority group) decreases population health (p_{tot}) and results in a higher index value. Thus, even if two states have equal levels of health for the two subgroups, the state with the larger minority group will be deemed more inequitable, although the size of the minority group in that state is not itself subject to public health intervention. In these cases, adjusting for the states' population composition would result in "fairer" rankings. See "Calibrating summary inequalities indices for comparability between states" for more information.

A third drawback of the Gastwirth indices, as with other summary indices, is that they measure inequality solely, regardless of health levels (e.g., the health of the least healthy subgroup, or the average health of the population) (49). See "Calibrating summary inequalities indices for comparability between states" for this report's strategy to adjust summary inequalities indices for population health levels.

Atkinson summary index

For this report, summary indices also were developed using the Atkinson index, which derives from the theory of welfare economics and is often used in the study of health inequalities (50–52). Relatedly, the UNDP uses the Atkinson index to *adjust* HDI for inequalities in its three component measures (12).

Actually, the Atkinson index is a family of summary indices A_α, with values between 0 and 1, given by

$$A_\alpha = 1 - \exp(-\text{RI}_\alpha)$$

The RI_α in this expression is the Rényi index, written as follows to showcase the population weights f_j and the ratios $p_j \ / \ p_{\text{tot}}$ comparing each population group's proportion to the population average:

$$\mathrm{RI}_\alpha = -\frac{1}{1-\alpha} \times \ln\left\{\sum f_j \times \left(\frac{p_j}{p_{\mathrm{tot}}}\right)^{1-\alpha}\right\}$$

when $\alpha \neq 1$, $\alpha > 0$; and

$$\mathrm{RI}_1 = -\sum f_j \times \ln\left(\frac{p_j}{p_{\mathrm{tot}}}\right)$$

when $\alpha = 1$. The index RI_1 is the mean log deviation index.

The Atkinson index A_α is equal to zero only if all the p_j are the same. The parameter α is positive, and it is a constant relative inequality aversion parameter; as a result, A_α is nondecreasing with increasing values of α. The Atkinson index also satisfies foundational principles in inequality measurement, including the principles of transfers, population replication, and subgroup decomposability (52).

In contrast to the Gastwirth index, the Atkinson index explicitly recognizes the tradeoff between reducing inequality and improving health for all. From the above expressions, the index A_α is given by:

$$A_\alpha = 1 - \frac{p_{\mathrm{tot}}^{(\alpha)}}{p_{\mathrm{tot}}}$$

where, for $\alpha = 1$,

$$p_{\mathrm{tot}}^{(1)} = \exp\left(\sum f_j \times \ln p_j\right)$$

is the population-weighted geometric average of the p_j, and, for $\alpha \neq 1$, $\alpha > 0$,

$$p_{\mathrm{tot}}^{(\alpha)} = \left(\sum f_j \times p_j^{1-\alpha}\right)^{1/(1-\alpha)}$$

is a generalized population-weighted geometric average.

As α increases, the generalized geometric average $p_{\mathrm{tot}}^{(\alpha)}$ gives more weight to those groups with less favorable proportions p_j. Because $p_{\mathrm{tot}}^{(\alpha)}$ is necessarily less than or equal to p_{tot}, the tradeoff is revealed: A_α is the relative reduction in the overall health level that society would, hypothetically, be willing to accept in exchange for achieving equality (i.e., hypothetically, $p_j \equiv p_{\mathrm{tot}}^{(\alpha)}$ for all groups). The larger the aversion to inequality, the more society is willing to accept the ensuing reduction in the overall health levels.

With infinite inequality aversion, society would accept a full reduction for achieving equality:

$$p_j \equiv p_{\min} \text{ and } A_\infty = 1 - \frac{p_{\min}}{p_{\mathrm{tot}}}$$

Consistent with the Rawlsian view that society is only as healthy as its least healthy group, increasing the relative size of the less healthy group(s) decreases the A_∞ index values toward zero. Because $A_\alpha \leq A_\infty$ for all α, it follows that the A_α index values also will tend to zero.

Unlike the Gastwirth index, whether the A_α index values will decrease or increase with a larger share f_1 of the minority group depends on the differential decrease between $p_{\mathrm{tot}}^{(\alpha)}$ and p_{tot}. For example, in the case of two population subgroups with proportions $p_1 < p_2$, the index A_1 (for $\alpha = 1$) will first increase when f_1 increases from 0 to f, then decrease when f_1 increases from f to 1, with $f = \frac{1}{\ln p_1 - \ln p_2} - \frac{p_2}{p_1 - p_2}$.

To further highlight the differences between the Gastwirth and Atkinson indices, note that the relative Gastwirth index G may be written as

$$G = \frac{1}{\sum f_j \times (p_j/p_{\max})} - 1$$

In contrast, for $\alpha = 2$, the Atkinson index A_2 is given by

$$A_2 = 1 - \frac{1}{\sum f_j \times (p_{\mathrm{tot}}/p_j)}$$

where inequalities are assessed relative to the average of subgroup proportions p_{tot} instead of the most favorable group proportion $p_{\max}$. For $\alpha = 1$, the Atkinson index A_1 is a standardized mean log deviation:

$$A_1 = 1 - \exp\left\{\sum f_j \times \ln(p_j/p_{\mathrm{tot}})\right\}$$

In addition, for $\alpha = 0.5$, the Atkinson index $A_{0.5}$ is given by

$$A_{0.5} = 1 - \left(\sum f_j \times \sqrt{p_j/p_{\mathrm{tot}}}\right)^2$$

The natural logarithm and square root functions in A_1 and $A_{0.5}$, respectively, have the effect of penalizing departures of the ratio p_j / p_{tot} from the value 1 (which reflects parity) at different rates than the reciprocal function in A_2. In addition, for $\alpha \geq 1$, the Atkinson index value may become maximal (equals 1) or near maximal (less than, but near, 1) whenever a population subgroup has zero or near zero percentage of adults who meet the selected criteria (due to division by zero for $\alpha > 1$; or the logarithm of zero for $\alpha = 1$). For this reason, the Atkinson index with $0 < \alpha < 1$ may be preferred to the Atkinson index with $\alpha \geq 1$.

Calibrating summary inequalities indices for comparability between states

Holding the most favorable proportion, $p_{\max}$, constant, the upper limit U_∞ for the Gastwirth index U is when the population composition is such that only a single individual achieves the most favorable proportion and all other groups have zero proportion, resulting in $U_\infty = p_{\max}$. In this case, the population average p_{tot} is practically zero, so the index G_∞ would be infinite due to division by zero.

Although an adjusted Gastwirth index $G^* = G / G_\infty$ would not yield a viable measure for comparisons across states because its denominator is infinite, the adjusted Atkinson index $A_\alpha^* = A_\alpha / A_\infty$ would. The index A_α^* adjusts the Atkinson index A_α by the reduction in health that a state would, hypothetically, be willing to trade off in order for all groups to be no healthier than the least healthy group.

Despite not directly addressing the differences across states in population composition, the adjusted Atkinson index does account for differences across states in the health of the least healthy group (often a minority or traditionally disadvantaged group).

Aggregating summary and composite inequalities indices

Various options were available for constructing an aggregate index I from a set of component indices I_1, I_2, …, I_K. The arithmetic mean,

$$I = (I_1 + I_2 + \cdots + I_K)/K$$

is known to be heavily influenced by extreme values of the component indices. To improve the stability of the average and to ensure that, say, a 1% reduction in any one component I_k , k = 1, 2, …, K, had the same impact on the aggregate I as a 1% reduction in any of the other components, the average was computed using the geometric instead of the arithmetic mean:

$$I = [I_1 \times I_2 \times \ldots \times I_K]^{1/K}$$

(Note: For any positive scalars a_1, a_2, …, a_k, the geometric–arithmetic mean inequality holds:

$[a_1 \times a_2 \times \ldots \times a_k]^{1/k} \leq$
$[a_1 + a_2 + \ldots + a_k]/k$

Moreover, a 1% reduction in a_1, say, has the same impact on the geometric mean as a 1% reduction in a_2 (or any of the other scalars): $[(0.99 \times a_1) \times a_2 \times \ldots \times a_k]^{1/k} = [a_1 \times (0.99 \times a_2) \times \ldots \times a_k]^{1/k}$. This is not the case for the arithmetic mean: $[(0.99 \times a_1) + a_2 + \ldots + a_k]/k \neq [a_1 + (0.99 \times a_2) + \ldots + a_k]/k$.)

Due to the form of the Gastwirth and Atkinson summary indices, as

$$G = \frac{p_{\max}}{p_{\text{tot}}} - 1 \text{ and } A_\alpha = 1 - \frac{p_{\text{tot}}^{(\alpha)}}{p_{\text{tot}}},$$

aggregate indices were calculated as:

$G = [(1 + G_1) \times (1 + G_2) \times \ldots \times (1 + G_K)]^{1/K} - 1$

$A_\alpha = 1 - [(1 - A_{1,\alpha}) \times (1 - A_{2,\alpha}) \times \ldots \times (1 - A_{K,\alpha})]^{1/K}$

This expresses the aggregates directly in terms of the ratios $\frac{p_{k,\max}}{p_{k,\text{tot}}}$ and $\frac{p_{k,\text{tot}}^{(\alpha)}}{p_{k,\text{tot}}}$ for each of the K components. For example, the composite Gastwirth index was given by

$$G = \left[\frac{p_{1,\max}}{p_{1,\text{tot}}} \times \frac{p_{2,\max}}{p_{2,\text{tot}}} \times \ldots \times \frac{p_{5,\max}}{p_{5,\text{tot}}}\right]^{1/5} - 1 = \frac{\left[p_{1,\max} \times p_{2,\max} \times \ldots \times p_{5,\max}\right]^{1/5}}{\left[p_{1,\text{tot}} \times p_{2,tot} \times \ldots \times p_{5,\text{tot}}\right]^{1/5}} - 1$$

The numerator in the above fraction is the geometric mean of the five most favorable population subgroup proportions $p_{1,\max}$, $p_{2,\max}$, …, and $p_{5,\max}$ (corresponding to the five population attributes). The denominator is the geometric mean of the averages of subgroup proportions for each attribute. The latter are generally equal to the marginal population mean, but they may differ slightly when respondents have missing values in any of the five attributes (e.g., educational attainment or disability status). Thus, the composite G index is expressed similar to each of the component summary indices, and it can be interpreted as the relative "cost" of bringing all worse-off population subgroups to parity with an average most-favorable subgroup proportion, where the average is over all five population attributes.

The percentage contribution to the aggregate index from each of the component indices also was calculated on the log scale for $I_k = 1 + G_k$ or $I = A_{k,\alpha} - 1$. For example, the contribution of the summary Gastwirth index G_{i1} of inequalities in core health measure i by population attribute 1 (e.g., sex) to the composite Gastwirth index G was calculated using:

$$\frac{\ln(1 + G_{i1})}{\ln(1 + G_{i1}) + \ln(1 + G_{i2}) + \cdots + \ln(1 + G_{i5})} \times 100$$

The contribution of the inequalities by population attribute 1 (e.g., sex) was calculated using:

$$\frac{\ln(1 + G_{11}) + \ln(1 + G_{21}) + \ln(1 + G_{31}) + \ln(1 + G_{41})}{\ln(1 + G_{11}) + \cdots + \ln(1 + G_{15}) + \cdots + \ln(1 + G_{41}) + \cdots + \ln(1 + G_{45})} \times 100$$

where G_{ij} is the summary index of inequalities by population attribute j in core health measure i.

Dependence on sampling variability and measurement assumptions

States could be ranked by their score on the overall, composite, and summary health inequalities indices constructed. For each of the resulting state rankings, the analysis in this report accounted for the design-based sampling variability of these rankings, as well as their sensitivity to assumptions and measurement decisions (e.g., the choice of index [Gastwirth or Atkinson family] for the summary indices).

Sampling variability of ranks

Sets of bootstrapped sampling weights were created from the sample adults' weights. With the stratified multistage design of NHIS, this bootstrap procedure is akin to the jackknife method of variance estimation, is attributed to Rao and Wu (53), and is described elsewhere (50,51,54). Briefly, replicate weights were created as follows: for each (pseudo)stratum h, $m_h = n_h - 1$ (pseudo-)PSUs were selected with replacement from the n_h PSUs in that stratum; weights for sample adults in PSUs not included in a given bootstrap replicate were set to 0; weights in PSUs that were included in the bootstrap replicate were multiplied by $k \times n_h / (n_h - 1)$, where k is the number of times each selected PSU was selected. This procedure was repeated a large number of times. The SAS macros used for this report to implement the bootstrap and calculate and rank the summary, composite, and overall Gastwirth and Atkinson indices are available from the authors upon request.

The bootstrapped weights allowed for a bootstrap distribution of the joint rankings of the 20 states. To estimate the joint rankings distribution with acceptable precision, 1,000 sets of bootstrapped weights were generated. To avoid overcoverage that would result from contiguous 90% confidence intervals (CIs) around a state's rank, 90% highest probability regions (HPRs) were computed instead. Each set of sampling weights resulted in a possibly different ranking of the 20 most populous states. The 90% HPR for each state consisted of the most likely ranks that each state was assigned in 9 out of 10 bootstrapped samples.

For example, if New York ranked third on a particular index, with a 90% HPR given by the set of ranks {1–4, 6}, this would indicate that the 90% most likely ranks for New York among the 20 most populous states were 1, 2, 3, 4, or 6, conveying the uncertainty about the rank estimate of 3. Note that the bootstrapped 90% HPR for any given state may or may not cover the rank estimate for that state.

Confidence intervals for most favorable subgroup percentages

The bootstrapped 95% CIs for subgroup percentages generally were in agreement with the 95% CIs obtained using the Korn–Graubard adjustment to the Clopper–Pearson method. However, the bootstrapped CIs for the most favorable subgroup percentages tended to be wider than the Korn–Graubard CIs for subgroup percentages in the subgroups that achieved the most favorable percentages; for some examples, see Supplemental Tables I–1a through I–4e. This was because each bootstrapped sample randomized not only the percentage achieved by each population subgroup, but also which subgroup achieved the most favorable percentage.

Sensitivity to measurement assumptions

In addition to the Gastwirth index, summary indices were constructed from the Atkinson index class. State rankings obtained from the former were compared with those obtained from the Atkinson indices.

Due to the dependence of population-weighted measures, such as the Gastwirth and Atkinson indices, on the underlying population composition (i.e., the relative sizes of population subgroups for a given population attribute), an adjustment to the Atkinson indices adjusted each state's index value by the value of the Atkinson index corresponding to an infinite inequality aversion, as previously described in "Calibrating summary inequalities indices for comparability between states."

Results

The 20 summary Gastwirth indices (5 population attributes times 4 health measures) from the first stage of the overall index construction illustrated in Figure 1 are shown in Table 1a for healthy behaviors, Table 2a for access to medical care, Table 3a for general physical health status and mental health, and Table 4a for absence of multiple chronic conditions. Results using the Atkinson summary indices were similar to those presented in these tables and are not included in this report.

The four composite Gastwirth indices from the second stage of the overall index construction are shown in Tables 1b, 2b, 3b, and 4b. Similar tables showing the composite Atkinson indices are not included. Although the percentage contributions to the composite from the summary indices were generally consistent between the two index classes, the Atkinson class resulted in different state rankings, as discussed below.

The overall, multidimensional Gastwirth indices are shown in Table 5.

By way of illustration, the summary Gastwirth indices of inequalities in healthy behaviors in Arizona were 0.06 by sex, 0.23 by race and Hispanic origin, 0.45 by education, 0.21 by urbanicity, and 0.07 by disability status (Table 1a). As previously described in "Aggregating summary and composite inequalities indices," these summary indices were aggregated using the following geometric mean:

$$[(1 + 0.06) \times (1 + 0.23) \times (1 + 0.45) \times (1 + 0.21) \times (1 + 0.07)]^{1/5} = [2.5]^{1/5} \approx 1.20$$

Thus, the composite Gastwirth index of inequalities in healthy behaviors for Arizona was 1.20 – 1 = 0.20 (Table 1b).

Table 1b also shows the percentages that the inequalities by each population attribute contributed to the composite Gastwirth index. These percentages were derived from the summary Gastwirth indices as previously described in "Aggregating summary and composite inequalities indices." For example, the contribution of race and Hispanic origin to the composite inequalities in healthy behaviors in Arizona was 23.1%:

$$\frac{\ln(1 + 0.23)}{\ln(1 + 0.06) + \ln(1 + 0.23) + \ln(1 + 0.45) + \ln(1 + 0.21) + \ln(1 + 0.07)}$$

$$\approx \frac{0.2075}{0.895} \approx 0.231$$

Continuing with the indices for Arizona, the overall Gastwirth index in turn aggregated the composite Gastwirth indices of inequalities in healthy behaviors (0.20), access to medical care (0.18), general physical health status and mental health (0.12), and absence of multiple chronic conditions (0.08):

$$[(1 + 0.20) \times (1 + 0.18) \times (1 + 0.12) \times (1 + 0.08)]^{1/4} - 1 = [1.7]^{1/4} - 1 \approx 0.14$$

as shown in Table 5.

The percentage contributions from inequalities in each core health measure and by each population attribute to the overall inequalities index are also shown in Table 5. The percentage contribution from each of the four core health measures to the overall index was calculated in the same way as described above, based on the composite *G* indices for each measure. However, the contribution from each population attribute cut across the components of the four composite indices (Figure 1). For example, the contribution of inequalities by sex to the overall index in Arizona was 5%. As previously explained in "Aggregating summary and composite inequalities indices," this was derived from

$$\frac{\ln(1+0.06)+\ln(1+0.01)+\ln(1+0.04)+\ln(1+0.03)}{\sum_i\sum_j \ln\left(1+G_{ij}\right)} \approx \frac{0.137}{2.7} \approx 0.05$$

where the numerator consists of a sum over all four summary indices of inequalities by sex, and the denominator is a sum over all 20 summary indices G_{ij} (five for each of the four core health measures).

Note that rounding discrepancies may occur when using the values shown in the tables for the above calculations. The values of composite and overall indices shown in the tables, as well as the percentage contributions thereto, were calculated using unrounded values prior to rounding and tabulation.

Impact of prevalence on aggregate inequalities. The lower prevalence of healthy behaviors (HBs, 16.4%) among U.S. adults aged 45–64 resulted in inequalities in HBs accounting for significantly more of the overall index than inequalities in access to medical care (AMC, 65.0% prevalence), general physical health status and mental health (PMH, 77.1%), or absence of multiple chronic conditions (MCCs, 68.6%) in 19 of the 20 most populous states; see Supplemental Table I–5 for U.S. prevalence estimates. This finding likely can be generalized for the proposed multidimensional health inequalities indices—that less prevalent outcomes will contribute more to inequalities than more prevalent outcomes.

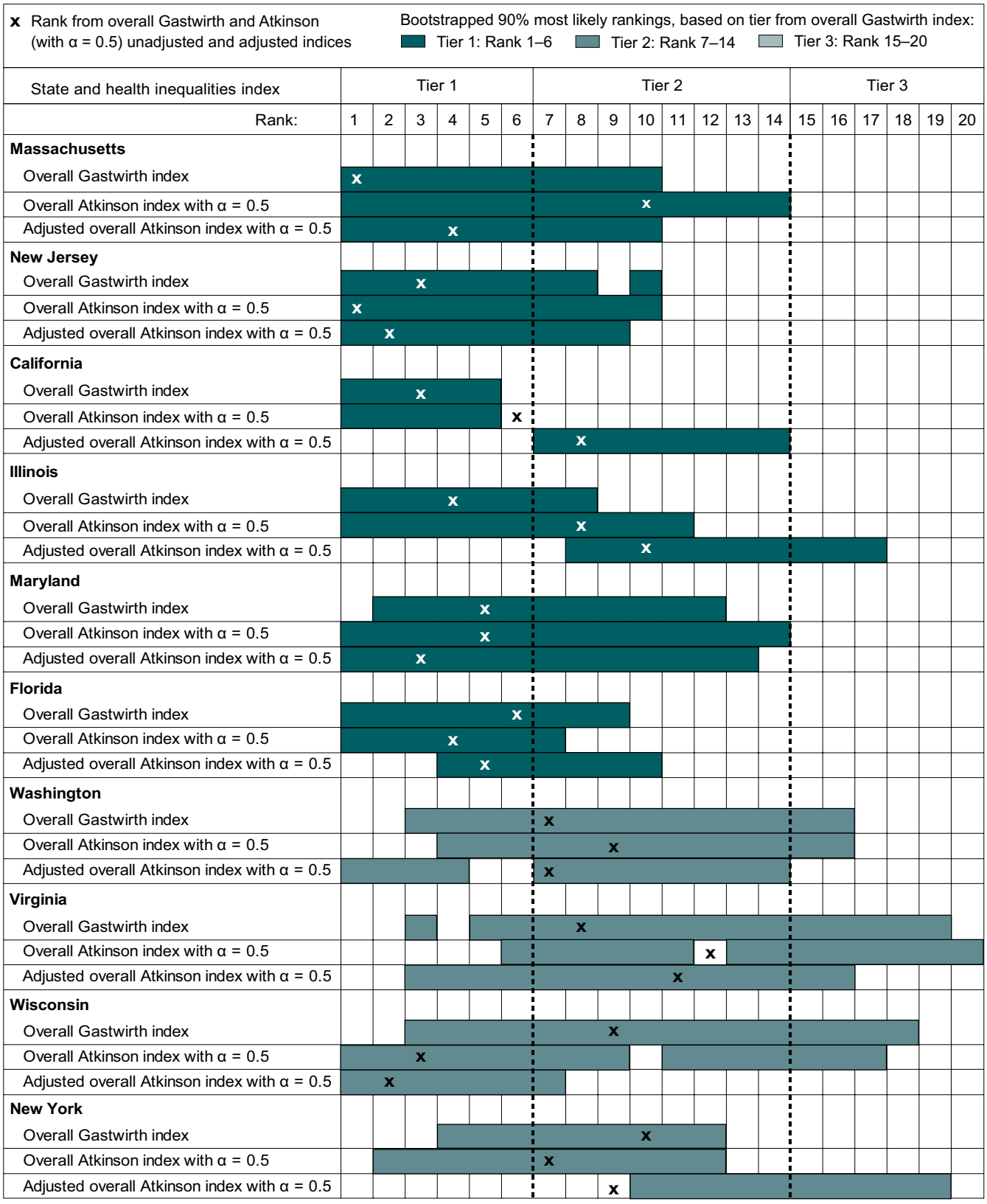
Differentiability between states with respect to health inequalities therein. The differentiability between states based solely on inequalities in the core measures or by the population attributes selected was relatively low in the example analyzed in this report. Composite *G* index values were right-skewed and ranged from 0.13 to 0.44 for inequalities in HBs (Table 1b), 0.05 to 0.18 for inequalities in AMC (Table 2b), 0.05 to 0.19 for inequalities in PMH (Table 3b), and 0.05 to 0.17 for inequalities in absence of MCCs (Table 4b). Similarly, overall *G* index values ranged from 0.08 to 0.20 (Table 5). (The *G* index is generally between 0.00 and 1.00.) On the other hand, inequalities by education contributed significantly more than inequalities by sex, race and Hispanic origin, urbanicity, or disability status in 14 of the 20 states (Table 5). Those with at least a 4-year college degree achieved the most favorable percentages for meeting the selected criteria for HBs, AMC, PMH, and absence of MCCs in all 20 states (Supplemental Tables I–1c, I–2c, I–3c, and I–4c). This finding likely holds in general: Because they aggregate inequalities only, regardless of population health levels, the proposed multidimensional health inequalities indices will not have high sensitivity in differentiating between states. As discussed below, inequality-adjusted health indices, akin to UNDP's inequality-adjusted HDI, may be more sensitive.

Impact of survey design and sampling variability. Variability across the 1,000 bootstrapped samples in the index estimates and rankings therein was reflected in the widths of the bootstrapped 95% CIs and the size of the set of 90% most likely rankings for each state (Tables 1b, 2b, 3b, 4b, and 5). For instance, variability in the overall *G* index rankings was such that, for example, the 90% most likely rankings for Tennessee included 5 likely ranks, 16–20, whereas those for Wisconsin included 16 likely ranks, 3–18 (Table 5).

Dependence of state rankings on index class selection. Rank uncertainty was a further reflection of the low differentiability between states based on inequalities in the selected health measures. State rankings also depended on index class selection. Table 6 compares the states' rankings when the Gastwirth index *G* and the unadjusted and adjusted Atkinson indices A_α and A_α^*, $\alpha = 0.5$, 1, or 2, were used in the construction of the state-specific overall indices. Generally, the rankings based on the overall Gastwirth index were not identical to those that were based on the Atkinson index class. Differences were also seen in the state rankings from the Atkinson indices depending on the value of the parameter α, and whether the indices had been adjusted.

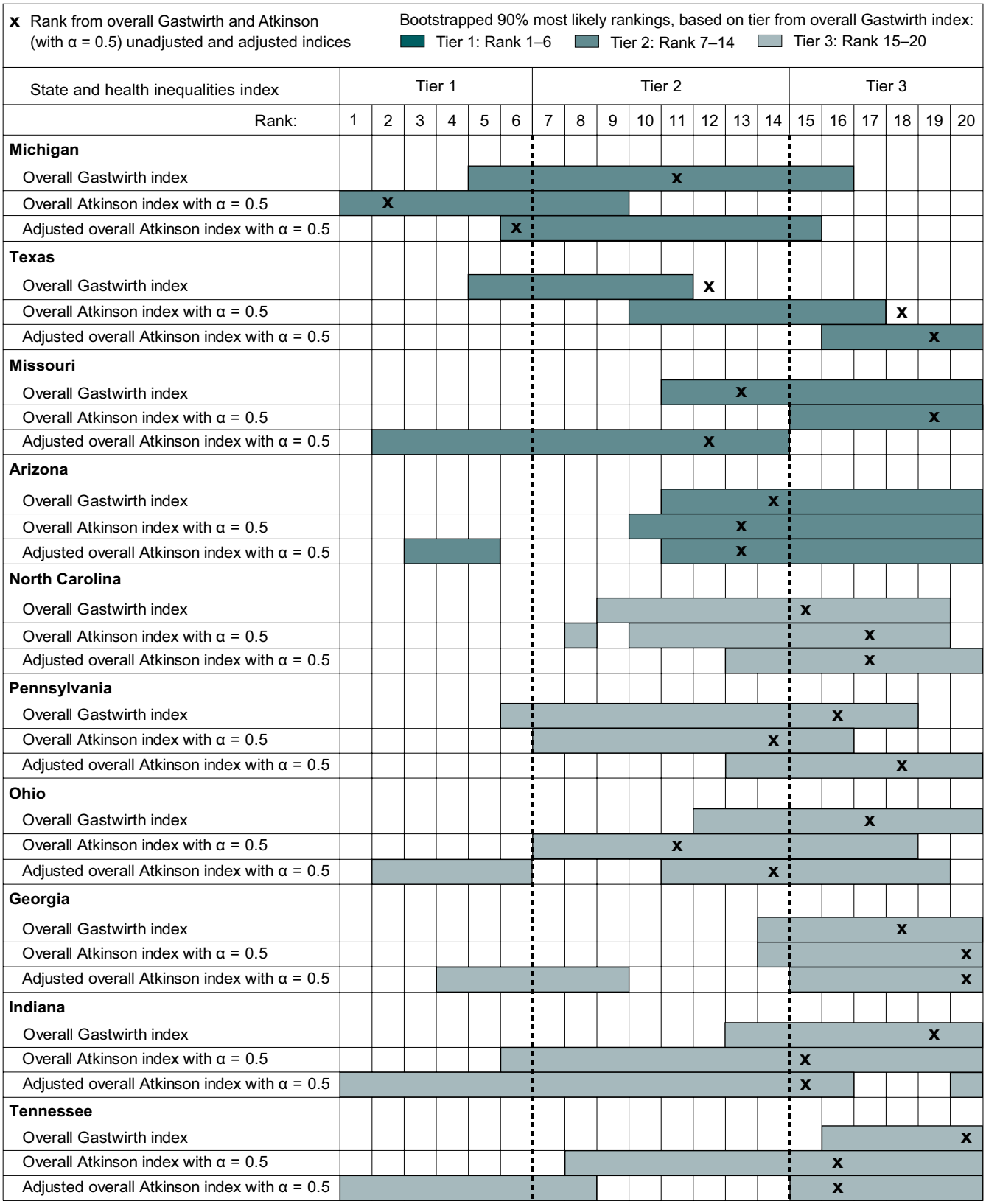
Consistency of rank tiers across index classes. Ranks from the overall Gastwirth and Atkinson indices constructed for this analysis generally clustered together. For simplicity of comparison, three tiers of state rankings were considered: those ranked 1–6, in tier 1; those ranked 7–14, in tier 2; and those ranked 15–20, in tier 3. Using the tiers from the overall *G* index as reference, Figure 2 provides a visual display of the information in Table 6 for the overall *G*, unadjusted $A_{0.5}$, and adjusted $A_{0.5}$ indices. Rank tiers from the unadjusted $A_{0.5}$ index matched those from the overall *G* index in 12 states. Rank tiers from the adjusted $A_{0.5}$ index matched those from the overall *G* index in 14 states. Rank tiers from the unadjusted and adjusted $A_{0.5}$ indices were consistent in 16 states. In addition, rankings from the overall *G*, unadjusted $A_{0.5}$, and adjusted $A_{0.5}$ indices that fell in different ranking tiers were such that their ranking from one index was no more than one tier away from their ranking from another index (i.e., moving from one index to another results in changes in rankings from tier 1 to tier 2; tier 2 to tiers 1 or 3; or tier 3 to tier 2; but no changes from tier 1 to tier 3 or tier 3 to tier 1).

Figure 2. Rankings from overall Gastwirth and Atkinson unadjusted and adjusted indices of demographic and socioeconomic inequalities in selected core health measures for the 20 most populous states among adults aged 45–64: National Health Interview Survey, 2013–2015



See footnotes at end of table.

Figure 2. Rankings from overall Gastwirth and Atkinson unadjusted and adjusted indices of demographic and socioeconomic inequalities in selected core health measures for the 20 most populous states among adults aged 45–64: National Health Interview Survey, 2013–2015—Con.



NOTES: States are sorted by their rank on the overall Gastwirth index. For simplicity of comparison to the unadjusted and adjusted Atkinson indices, three tiers of state rankings are presented: Those ranked 1–6 by the overall Gastwirth index are in tier 1, those ranked 7–14 in tier 2, and those ranked 15–20 in tier 3. Shaded horizontal bars show the coverage of the 90% most likely ranks for each selected state and index.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Sensitivity to zero subgroup proportions. As discussed in Methods, the Atkinson index may either achieve or closely approach its maximal value (equals 1) whenever a population subgroup has zero or near zero percentage of adults who met the selected criteria. States for which this occurred ended up with a tier 3 rank when the inequality aversion parameter in the Atkinson index was changed from $\alpha = 0.5$ to $\alpha = 1$ or 2. For example, as shown in Supplemental Table I–1c, the percentages of adults aged 45–64 meeting the selected criteria of healthy behavior for those with less than a high school education were 0.5% in Massachusetts and 0.8% in Washington (both 95% CI: 0.0–7.1). These states ranked, alternatively, 19 and 20 in the unadjusted and adjusted Atkinson indices for $\alpha = 2$ (Table 6).

Discussion

This report highlights some of the methodological issues that arise in the construction and design-based estimation of overall, multidimensional health inequalities indices among adults aged 45–64 in core measures of health, using state-level NHIS data as an example. Four core measures of health were selected: healthy behaviors, access to medical care, general physical health status and mental health, and absence of multiple chronic conditions. Inequalities were assessed across subgroups defined by sex, race and Hispanic origin, education, urbanicity, and disability status.

The lower prevalence of healthy behaviors among U.S. adults aged 45–64 during 2013–2015 resulted in inequalities in healthy behaviors accounting for significantly more of the overall index than inequalities in access to medical care, general physical health status and mental health, or absence of multiple chronic conditions in 19 of the 20 most populous states. This pattern is likely to be generalized for multidimensional health inequalities indices, because relative inequalities tend to be larger for less prevalent health outcomes than for more prevalent outcomes (55).

Differences were seen in the state rankings depending on which of the three overall Atkinson indices (with $\alpha = 0.5$, 1, or 2) was used, and whether the index had been adjusted for the health of the least healthy group. Rankings based on the overall Gastwirth index also differed from those that were based on the Atkinson family. Yet, in this analysis, the majority of the 20 states were ranked in consistent tiers by the overall G and A_α indices, indicating some degree of robustness in the choice of summary index class.

The framework described in this report allowed for ranking states according to the level of inequalities therein. Because they aggregate multiple component indices into a single indicator, multidimensional indices, such as the composite and overall indices constructed for this report, reflect the analyst's assumptions and choices in the selection of variables, definition of measures, and weighting of components (21–24). Thus, rankings based on such multidimensional indices also depend on these measurement assumptions and choices. The framework in this report allowed, to the extent possible, for underlying measurement assumptions to be made explicit, and it offered a way to quantify rank uncertainty that was due to the survey design and sampling variability.

Smaller or less diverse states will tend to have more rank uncertainty than larger or more diverse states. The large degree of uncertainty in the ranking of states based on the overall and composite inequalities indices also reflects the difficulty in differentiating between states solely using inequalities in the health measures selected. Indeed, summary inequalities indices, which are the disaggregated components of the overall and composite indices, solely measure inequality, regardless of population composition or health levels. The adjusted Atkinson indices used in this report could account for differences across states in the health of the least healthy group, but, still, they did not fully account for differences in population composition and health levels between states. In addition, in the data analyzed for this report, the adjusted Atkinson indices generally produced the same rank tiers as their unadjusted counterparts. The report did not explore alternative adjustments to the indices, such as adjusting population subgroup percentages by the direct method prior to computing summary indices.

Inequality-adjusted health indices, akin to UNDP's inequality-adjusted HDI (12), may enhance differentiability between states and reduce ranking uncertainty. However, this approach would also have its challenges, most notably the lack of comparability of population health levels across multiple health measures (e.g., more than 600 measurable, population-based HP2020 indicators) that capture different constructs or domains, or that are measured using different scales (e.g., percentages, rates per 100,000, or mean levels). Relative indices such as the Gastwirth and Atkinson indices are dimensionless and scale-free, and, therefore, facilitate broad comparisons using multidimensional aggregates.

In the example analyzed, because an *a priori* rationale for doing otherwise was lacking, equal weights were given to: the five population attributes, the subgroups defined by each population attribute, the inequalities in the four core measures of health, and the component criteria in the four core measures (e.g., three criteria for healthy behaviors, three for access to medical care, and two for general physical health status and mental health). A different weighting scheme could be selected, for example, that was based on a consensus derived from an expert panel and evidence-based scientific research. Further, alternative variable definitions or numerical cutoffs for the component health measures, such as "heavy alcohol use" (56) or NSPD (57), could be considered. While the methodological exercise of this report could not evaluate all of these considerations, researchers interested in using these methods could conduct a more complete investigation of the sensitivity of multidimensional inequality indices and health measures to the effect of weighting, measure definitions, and other substantive issues.

References

1. Talih M, Huang DT. Measuring progress toward target attainment and the elimination of health disparities in Healthy People 2020. Healthy People Statistical Notes, no 27. Hyattsville, MD: National Center for Health Statistics. 2016. Available from: https://www.cdc.gov/nchs/data/statnt/statnt27.pdf.
2. National Center for Health Statistics. Chapter III: Overview of midcourse progress and health disparities. In: Healthy People 2020 midcourse review. Hyattsville, MD. 2016. Available from: https://www.cdc.gov/nchs/healthy_people/hp2020/hp2020_midcourse_review.htm.
3. National Center for Health Statistics. Healthy People 2020 midcourse review. Hyattsville, MD. 2016. Available from: https://www.cdc.gov/nchs/healthy_people/hp2020/hp2020_midcourse_review.htm.
4. Tsui K. Multidimensional inequality and multidimensional generalized entropy measures: An axiomatic derivation. Soc Choice Welfare 16(1):145–57. 1999.
5. Maasoumi E. The measurement and decomposition of multi-dimensional inequality. Econometrica 54(4):991–7. 1986.
6. Decancq K, Lugo MA. Measuring inequality of well-being with a correlation-sensitive multidimensional Gini index. Society for the Study of Economic Inequality. ECINEQ working paper 2009–124. 2009. Available from: http://www.ecineq.org/milano/WP/ECINEQ2009-124.pdf.
7. Asada Y, Yoshida Y, Whipp AM. Summarizing social disparities in health. Milbank Q 91(1):5–36. 2013.
8. Asada Y, Whipp A, Kindig D, Billard B, Rudolph B. Inequalities in multiple health outcomes by education, sex, and race in 93 US counties: why we should measure them all. Int J Equity Health 13:47. 2014.
9. National Center for Health Statistics. National Health Interview Survey: NHIS data, questionnaires and related documentation: 2015 NHIS: Survey description. Hyattsville, MD. 2016. Available from: https://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm.
10. Healthy People 2020. Data search: DATA2020. Washington, DC. Available from: https://www.healthypeople.gov/2020/data-search/.
11. America's Health Rankings. Minneapolis, MN. Available from: http://www.americashealthrankings.org/.
12. United Nations Development Programme. Human development report 2016: Human development for everyone. New York, NY: United Nations. 2016. Available from: http://report.hdr.undp.org/.
13. Alkire S, Santos ME. Measuring acute poverty in the developing world: Robustness and scope of the Multidimensional Poverty Index. World Dev 59:251–74. 2014.
14. Madans JH, Weeks JD. A framework for monitoring progress using summary measures of health. J Aging Health 28(7):1299–314. 2016.
15. National Center for Health Statistics. Chapter V: Foundation health measures. In: Healthy People 2020 midcourse review. Hyattsville, MD. 2016. Available from: https://www.cdc.gov/nchs/healthy_people/hp2020/hp2020_midcourse_review.htm.
16. National Center for Health Statistics. Chapter IV: Leading health indicators. Healthy People 2020 midcourse review. Hyattsville, MD. 2016. Available from: https://www.cdc.gov/nchs/healthy_people/hp2020/hp2020_midcourse_review.htm.
17. U.S. Department of Health and Human Services. Healthy People 2020: Leading health indicators. Washington, DC. Available from: https://www.healthypeople.gov/2020/Leading-Health-Indicators.
18. Institute of Medicine. Vital signs: Core metrics for health and health care progress. Washington, DC: The National Academies Press. 2015.
19. Adams ML, Katz DL, Shenson D. A healthy lifestyle composite measure: Significance and potential uses. Prev Med 84:41–7. 2016.
20. County Health Rankings & Roadmaps. Madison, WI. Available from: http://www.countyhealthrankings.org/.
21. Paruolo P, Saisana M, Saltelli A. Ratings and rankings: Voodoo or science? J R Stat Soc A 176(Pt 3):609–34. 2013.
22. Decancq K, Lugo MA. Weights in multidimensional indices of wellbeing: An overview. Econometric Rev 32(1):7–34. 2013.
23. Foster JE, McGillivray M, Seth S. Composite indices: Rank robustness, statistical association, and redundancy. Econometric Rev 32(1):35–56. 2013.
24. Maasoumi E, Lugo MA. Chapter 1: The information basis of multivariate poverty assessments. In: Kakwani N, Silber J, editors. Quantitative approaches to multidimensional poverty measurement. London: Palgrave Macmillan. 2008.
25. Parsons VL, Moriarity C, Jonas K, Moore TF, Davis KE, Tompkins L. Design and estimation for the National Health Interview Survey, 2006–2015. National Center for Health Statistics. Vital Health Stat 2(165). 2014.
26. Parker JD, Talih M, Malec DJ, Beresovsky V, Carroll M, Gonzalez JF Jr, et al. National Center for Health

Statistics data presentation standards for proportions. National Center for Health Statistics. Vital Health Stat 2(175). 2017.

27. National Center for Health Statistics. National Health Interview Survey: 2015 survey questionnaires. Hyattsville, MD. Available from: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Survey_Questionnaires/NHIS/2015/english/.

28. Ingram DD, Franco SJ. 2013 NCHS urban–rural classification scheme for counties. National Center for Health Statistics. Vital Health Stat 2(166). 2014.

29. U.S. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation. HHS implementation guidance on data collection standards for race, ethnicity, sex, primary language, and disability status. Washington, DC. 2011. Available from: https://aspe.hhs.gov/datacncl/standards/ACA/4302/index.shtml.

30. National Center for Health Statistics. National Health Interview Survey: 2015 data release: Data, questionnaires, and related documentation: Family disability questions file. Hyattsville, MD. Available from: https://www.cdc.gov/nchs/nhis/nhis_2015_data_release.htm.

31. U.S. Department of Health and Human Services. Healthy People 2020: Tobacco: Adult cigarette smoking (TU–1.1). Washington, DC. Available from: https://www.healthypeople.gov/2020/leading-health-indicators/2020-lhi-topics/Tobacco.

32. Centers for Disease Control and Prevention. Winnable battles: CDC winnable battles final report: Tobacco. Atlanta, GA. Available from: https://www.cdc.gov/winnablebattles/tobacco/index.html.

33. U.S. Department of Health and Human Services. Healthy People 2020: Leading health indicators: 2020 LHI topics: Substance abuse: Binge drinking in past month (SA–14.3). Washington, DC. Available from: https://www.healthypeople.gov/2020/leading-health-indicators/2020-lhi-topics/Substance-Abuse.

34. U.S. Department of Health and Human Services. Healthy People 2020: 2020 Topics & objectives: Substance abuse: Objectives: SA–15. Washington, DC. Available from: https://www.healthypeople.gov/2020/topics-objectives/topic/substance-abuse/objectives.

35. U.S. Department of Health and Human Services. Healthy People 2020: Leading health indicators: 2020 LHI topics: Nutrition, physical activity, and obesity: Adults meeting aerobic physical activity and muscle-strengthening objectives (PA–2.4). Washington, DC. Available from: https://www.healthypeople.gov/2020/leading-health-indicators/2020-lhi-topics/Nutrition-Physical-Activity-and-Obesity.

36. Centers for Disease Control and Prevention. Winnable battles: CDC winnable battles final report: Nutrition/physical activity/obesity. Atlanta, GA. Available from: https://www.cdc.gov/winnablebattles/obesity/index.html.

37. U.S. Department of Health and Human Services. Appendix 9: Alcohol. In: 2015–2020 Dietary guidelines for Americans, 8th ed. Washington, DC. Available from: https://health.gov/dietaryguidelines/2015/guidelines/appendix-9/.

38. U.S. Department of Health and Human Services. 2008 Physical activity guidelines for Americans. Washington, DC. 2008. Available from https://health.gov/paguidelines/pdf/paguide.pdf.

39. U.S. Department of Health and Human Services. Healthy People 2020: 2020 Topics & objectives: Access to health services. Washington, DC. Available from: https://www.healthypeople.gov/2020/topics-objectives/topic/Access-to-Health-Services.

40. Villarroel MA, Cohen RA. Health insurance continuity and health care access and utilization, 2014. NCHS Data Brief, no 249. Hyattsville, MD: National Center for Health Statistics. 2016.

41. Black LI, Schiller JS. State variation in health care service utilization: United States, 2014. NCHS Data Brief, no 245. Hyattsville, MD: National Center for Health Statistics. 2016.

42. Martinez ME, Ward BW, Adams PF. Health care access and utilization among adults aged 18–64, by race and Hispanic origin: United States, 2013 and 2014. NCHS Data Brief, no 208. Hyattsville, MD: National Center for Health Statistics. 2015.

43. U.S. Department of Health and Human Services. Healthy People 2020: 2020 Topics & objectives: Health-related quality of life & well-being. Washington, DC. Available from: https://www.healthypeople.gov/2020/topics-objectives/topic/health-related-quality-of-life-well-being/objectives.

44. Kessler RC, Barker PR, Colpe LJ, Epstein JF, Gfroerer JC, Hiripi E, et al. Screening for serious mental illness in the general population. Arch Gen Psychiatry 60(2):184–9. 2003.

45. National Center for Health Statistics. Health, United States, 2014: With special feature on adults aged 55–64. Figure 22 and Table 51. Hyattsville, MD. 2015.

46. U.S. Department of Health and Human Services. Multiple chronic conditions: A strategic framework. Optimum health and quality of life for individuals with multiple chronic conditions. Washington, DC. 2010. Available from: https://www.hhs.gov/ash/initiatives/mcc/mcc_framework.pdf.

47. Goodman RA, Posner SF, Huang ES, Parekh AK, Koh HK. Defining and measuring chronic conditions: Imperatives for research, policy, program, and practice. Prev Chronic Dis 10:E66. 2013.

48. Gastwirth JL. A graphical summary of disparities in health care and related summary measures. J Stat Plan Inference 137:1059–65. 2007.

49. Wagstaff A. Inequality aversion, health inequalities and health achievement. J Health Econ 21(4):627–41. 2002.

50. Talih M. Examining socioeconomic health disparities using a rank-dependent Rényi index. Ann Appl Stat 9(2):992–1023. 2015.

51. Talih M. A reference-invariant health disparity index based on Rényi divergence. Ann Appl Stat 7(2):1217–43. 2013.

52. Levy JI, Chemerynski SM, Tuchmann JL. Incorporating concepts of inequality and inequity into health benefits analysis. Int J Equity Health 5:2. 2006.

53. Rao JNK, Wu CFJ. Resampling inference with complex survey data. J Am Stat Assoc 83(401):231–41. 1988.

54. Cheng NF, Han PZ, Gansky SA. Methods and software for estimating health disparities: The case of children's oral health. Am J Epidemiol 168(8):906–14. 2008.

55. Penman-Aguilar A, Talih M, Huang D, Moonesinghe R, Bouye K, Beckles G. Measurement of health disparities, health inequities, and social determinants of health to support the advancement of health equity. J Public Health Manag Pract 22 Suppl 1:S33–42. 2016.

56. Roerecke M, Rehm J. Alcohol consumption, drinking patterns, and ischemic heart disease: A narrative review of meta-analyses and a systematic review and meta-analysis of the impact of heavy drinking occasions on risk for moderate drinkers. BMC Med 12:182. 2014.

57. Centers for Disease Control and Prevention. Non-specific psychological distress: Data and statistics: Mental health. Atlanta, GA. Available from: https://www.cdc.gov/mentalhealth/.

List of Internet Tables

Available from: https://www.cdc.gov/nchs/data/series/sr_02/sr02_180/sr02_180_tables.pdf

I–1a. Percentage of adults aged 45–64 meeting selected criteria for healthy behavior in the 20 most populous states, by sex: National Health Interview Survey, 2013–2015

I–1b. Percentage of adults aged 45–64 meeting selected criteria for healthy behavior in the 20 most populous states, by race and Hispanic origin: National Health Interview Survey, 2013–2015

I–1c. Percentage of adults aged 45–64 meeting selected criteria for healthy behavior in the 20 most populous states, by educational attainment: National Health Interview Survey, 2013–2015

I–1d. Percentage of adults aged 45–64 meeting selected criteria for healthy behavior in the 20 most populous states, by urbanicity: National Health Interview Survey, 2013–2015

I–1e. Percentage of adults aged 45–64 meeting selected criteria for healthy behavior in the 20 most populous states, by disability status: National Health Interview Survey, 2013–2015

I–2a. Percentage of adults aged 45–64 meeting selected criteria for access to medical care in the 20 most populous states, by sex: National Health Interview Survey, 2013–2015

I–2b. Percentage of adults aged 45–64 meeting selected criteria for access to medical care in the 20 most populous states, by race and Hispanic origin: National Health Interview Survey, 2013–2015

I–2c. Percentage of adults aged 45–64 meeting selected criteria for access to medical care in the 20 most populous states, by educational attainment: National Health Interview Survey, 2013–2015

I–2d. Percentage of adults aged 45–64 meeting selected criteria for access to medical care in the 20 most populous states, by urbanicity: National Health Interview Survey, 2013–2015

I–2e. Percentage of adults aged 45–64 meeting selected criteria for access to medical care in the 20 most populous states, by disability status: National Health Interview Survey, 2013–2015

I–3a. Percentage of adults aged 45–64 meeting selected criteria for general physical health status and mental health in the 20 most populous states, by sex: National Health Interview Survey, 2013–2015

I–3b. Percentage of adults aged 45–64 meeting selected criteria for general physical health status and mental health in the 20 most populous states, by race and Hispanic origin: National Health Interview Survey, 2013–2015

Table 1a. Summary Gastwirth indices of inequalities among adults aged 45–64 in meeting selected criteria for healthy behavior, by specified demographic and socioeconomic attributes in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Summary *G* index (95% CI)				
	Sex	Race and Hispanic origin	Education	Urbanicity	Disability status
Arizona	0.06 (0.00–0.43)	0.23 (0.10–1.40)	0.45 (0.24–1.09)	0.21 (0.04–1.14)	0.07 (0.01–0.33)
California	0.03 (0.00–0.14)	0.30 (0.21–0.68)	0.55 (0.40–0.69)	0.11 (0.02–0.50)	0.04 (0.00–0.09)
Florida	0.10 (0.00–0.29)	0.22 (0.09–0.67)	0.44 (0.21–0.61)	0.35 (0.02–1.04)	0.06 (0.01–0.14)
Georgia	0.38 (0.10–0.56)	0.11 (0.05–0.73)	0.72 (0.35–1.02)	0.45 (0.30–1.50)	0.12 (0.01–0.45)
Illinois	0.06 (0.00–0.22)	0.08 (0.04–0.50)	0.55 (0.38–0.90)	0.04 (0.02–0.50)	0.02 (0.00–0.37)
Indiana	0.53 (0.20–0.78)	1.47 (0.04–3.07)	0.12 (0.12–0.78)	0.32 (0.09–0.90)	0.12 (0.00–0.33)
Maryland	0.19 (0.01–0.47)	0.21 (0.06–0.75)	0.35 (0.18–0.82)	0.05 (0.02–0.60)	0.09 (0.01–0.25)
Massachusetts	0.04 (0.00–0.22)	0.06 (0.05–0.85)	0.39 (0.21–0.62)	0.19 (0.03–0.54)	0.01 (0.00–0.93)
Michigan	0.10 (0.01–0.27)	0.54 (0.11–1.40)	0.52 (0.25–0.89)	0.31 (0.05–1.03)	0.05 (0.00–0.39)
Missouri	0.28 (0.02–0.55)	0.09 (0.06–1.34)	0.43 (0.29–1.00)	0.23 (0.10–0.87)	0.16 (0.12–0.28)
New Jersey	0.11 (0.01–0.31)	0.25 (0.09–1.01)	0.43 (0.21–0.70)	0.02 (0.01–0.90)	0.03 (0.00–0.38)
New York	0.19 (0.01–0.35)	0.15 (0.12–0.31)	0.55 (0.31–0.85)	0.77 (0.25–1.50)	0.10 (0.02–0.22)
North Carolina	0.00 (0.00–0.19)	0.06 (0.03–1.16)	0.81 (0.50–1.10)	0.36 (0.10–0.59)	0.20 (0.10–0.32)
Ohio	0.05 (0.00–0.19)	0.84 (0.06–2.55)	1.05 (0.72–1.61)	0.12 (0.04–0.55)	0.11 (0.01–0.26)
Pennsylvania	0.11 (0.01–0.31)	0.85 (0.08–2.06)	0.92 (0.68–1.25)	0.08 (0.03–0.54)	0.15 (0.05–0.23)
Tennessee	0.25 (0.03–0.48)	0.26 (0.05–1.70)	0.79 (0.26–1.37)	0.36 (0.12–1.21)	0.16 (0.01–0.36)
Texas	0.18 (0.07–0.30)	0.25 (0.14–0.36)	0.82 (0.68–1.05)	0.18 (0.11–0.28)	0.15 (0.09–0.22)
Virginia	0.21 (0.01–0.42)	0.05 (0.05–1.38)	0.45 (0.27–0.80)	0.10 (0.07–0.57)	0.16 (0.05–0.28)
Washington	0.04 (0.00–0.22)	0.19 (0.04–1.48)	0.47 (0.24–0.78)	0.01 (0.02–0.43)	0.09 (0.00–0.28)
Wisconsin	0.07 (0.01–0.35)	0.31 (0.02–1.80)	0.37 (0.24–0.78)	0.61 (0.07–1.45)	0.04 (0.00–0.60)

NOTES: *G* is Gastwirth index. Confidence intervals (CIs) are bootstrapped 95% CIs obtained from sets of 1,000 bootstrapped replicates of the sample adult weights.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Table 1b. Composite Gastwirth indices of demographic and socioeconomic inequalities in healthy behaviors, percent contribution from component population attributes, and resulting state rankings among adults aged 45–64 in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Composite *G* index (95% CI)	Ranking by composite *G* index (90% most likely ranks)	Percent contribution of inequalities, by population attribute (95% CI)				
			Sex	Race and Hispanic origin	Education	Urbanicity	Disability status
Arizona	0.20 (0.17–0.56)	8 (3–19)	6.7 (0.4–25.3)	23.1 (8.6–49.4)	41.4 (15.5–52.0)	21.2 (4.0–52.7)	7.5 (0.5–19.7)
California	0.19 (0.17–0.30)	7 (2–10)	3.0 (0.2–12.5)	30.7 (20.0–45.5)	50.5 (31.3–55.6)	11.5 (2.1–34.1)	4.3 (0.4–9.1)
Florida	0.22 (0.15–0.36)	9 (1–12)	9.1 (0.4–24.4)	19.5 (8.2–47.7)	35.8 (16.5–50.6)	29.6 (1.9–53.0)	6.1 (1.0–14.9)
Georgia	0.34 (0.25–0.53)	16 (9–20)	22.3 (5.8–32.2)	6.9 (3.3–31.4)	37.4 (20.5–44.6)	25.5 (18.3–46.8)	8.0 (0.7–22.3)
Illinois	0.13 (0.14–0.31)	2 (1–7, 9)	8.7 (0.3–20.2)	12.3 (4.5–35.5)	69.8 (30.5–72.5)	5.6 (1.8–36.1)	3.6 (0.5–29.3)
Indiana	0.44 (0.22–0.72)	20 (8, 11–20)	23.3 (9.2–43.0)	49.2 (4.1–56.8)	6.3 (6.2–36.3)	15.1 (5.1–34.9)	6.1 (0.3–16.2)
Maryland	0.17 (0.13–0.35)	5 (1–11)	22.0 (1.1–38.3)	23.8 (6.6–47.1)	37.3 (17.3–59.3)	5.7 (2.6–34.7)	11.2 (1.1–23.1)
Massachusetts	0.13 (0.11–0.39)	1 (1–10, 13)	6.1 (0.3–21.0)	10.1 (5.2–46.1)	54.1 (16.6–60.8)	28.1 (3.7–43.2)	1.6 (0.5–47.5)
Michigan	0.29 (0.21–0.53)	13 (7–20)	7.7 (0.7–16.7)	34.0 (8.4–51.7)	33.2 (15.8–48.2)	21.6 (4.1–44.7)	3.6 (0.2–18.9)
Missouri	0.23 (0.21–0.55)	10 (6–20)	23.9 (1.3–31.5)	8.2 (4.6–43.1)	34.1 (16.3–47.6)	19.8 (6.5–38.0)	14.0 (6.7–20.5)
New Jersey	0.16 (0.12–0.39)	4 (1–11, 14)	14.5 (0.6–25.9)	30.5 (9.6–59.0)	48.4 (17.8–62.6)	3.0 (1.4–47.6)	3.6 (0.4–25.6)
New York	0.33 (0.24–0.46)	15 (9–19)	12.0 (0.9–20.1)	10.1 (7.4–19.6)	30.8 (20.4–41.2)	40.4 (18.7–55.1)	6.8 (1.4–12.9)
North Carolina	0.26 (0.20–0.49)	11 (5–18)	0.2 (0.3–12.9)	5.0 (2.8–42.4)	51.9 (27.0–59.6)	26.8 (8.6–31.7)	16.1 (6.6–21.8)
Ohio	0.37 (0.24–0.65)	18 (12–20)	2.8 (0.1–9.6)	38.4 (4.4–55.9)	45.3 (29.7–62.6)	6.9 (2.0–25.5)	6.6 (0.4–13.3)
Pennsylvania	0.37 (0.23–0.57)	19 (7–11, 13–20)	6.5 (0.6–17.7)	38.7 (6.4–52.2)	41.1 (27.3–65.7)	4.9 (2.4–27.2)	8.9 (3.1–16.2)
Tennessee	0.35 (0.22–0.67)	17 (9, 11–20)	14.8 (2.2–22.9)	15.4 (3.6–44.7)	39.0 (17.2–47.8)	20.7 (8.9–41.3)	10.1 (0.4–21.0)
Texas	0.30 (0.26–0.36)	14 (8–15)	12.9 (5.2–18.5)	17.0 (11.0–22.9)	46.3 (40.5–52.9)	13.0 (8.6–18.7)	10.9 (6.9–14.7)
Virginia	0.19 (0.16–0.51)	6 (2–18)	22.6 (1.2–28.5)	6.1 (4.9–49.0)	43.0 (20.9–46.0)	10.8 (6.4–39.1)	17.4 (4.5–18.9)
Washington	0.15 (0.13–0.41)	3 (1–13)	5.9 (0.2–20.4)	24.6 (5.2–59.7)	55.8 (18.9–62.2)	0.9 (2.2–31.2)	12.8 (0.3–23.1)
Wisconsin	0.27 (0.16–0.61)	12 (3, 5–20)	6.0 (0.5–23.4)	23.0 (1.9–52.4)	26.9 (11.3–49.4)	40.5 (5.8–57.1)	3.7 (0.4–25.4)
Range	*0.13–0.44*	*1–20*	*0.2–23.9*	*5.0–49.2*	*6.3–69.8*	*0.9–40.5*	*1.6–17.4*
Not significantly ≠ 0.10 in: [1]	*0 states*	…	…	…	…	…	…
Significantly < 20% in: [2]	…	…	*6 of 15 states*	*1 of 10 states*	*0 of 1 state*	*1 of 11 states*	*10 of 20 states*
Significantly > 20% in: [3]	…	…	*0 of 5 states*	*0 of 10 states*	*9 of 19 states*	*0 of 9 states*	*0 of 0 states*

… Category not applicable.

[1]Index not significantly different from 0.10 at the 0.05 level of significance.
[2]Percent contribution to index is below the reference value of 20% and significantly different from 20% at the 0.05 level of significance for the number of states indicated.
[3]Percent contribution to index is above the reference value of 20% and significantly different from 20% at the 0.05 level of significance for the number of states indicated.

NOTES: The composite Gastwirth (*G*) index and percent contributions are calculated as described in NCHS Vital and Health Statistics Series 2, No. 180, under "Aggregating summary and composite inequalities indices." However, due to rounding, calculations using the tabulated index values may result in different values than those based on the unrounded index values. Confidence intervals (CIs) are bootstrapped 95% CIs obtained from sets of 1,000 bootstrapped replicates of the sample adult weights. Each of the 1,000 sets of bootstrapped sampling weights results in a possibly different ranking of the 20 most populous states by the composite *G* index. The 90% most likely ranks for each state are the most likely ranks that each state is assigned in 9 out of 10 bootstrapped samples.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Table 2a. Summary Gastwirth indices of inequalities among adults aged 45–64 in meeting selected criteria for access to medical care, by specified demographic and socioeconomic attributes in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Summary *G* index (95% CI)				
	Sex	Race and Hispanic origin	Education	Urbanicity	Disability status
Arizona	0.01 (0.00–0.15)	0.50 (0.10–0.71)	0.24 (0.10–0.42)	0.18 (0.07–0.43)	0.05 (0.00–0.14)
California	0.05 (0.02–0.08)	0.13 (0.08–0.19)	0.14 (0.12–0.20)	0.01 (0.00–0.07)	0.07 (0.06–0.10)
Florida	0.04 (0.00–0.08)	0.08 (0.03–0.29)	0.18 (0.11–0.24)	0.03 (0.01–0.11)	0.06 (0.02–0.09)
Georgia	0.01 (0.00–0.07)	0.08 (0.05–0.34)	0.27 (0.16–0.37)	0.04 (0.01–0.22)	0.15 (0.09–0.23)
Illinois	0.02 (0.00–0.08)	0.03 (0.01–0.20)	0.16 (0.09–0.25)	0.06 (0.04–0.08)	0.09 (0.05–0.12)
Indiana	0.03 (0.00–0.10)	0.20 (0.01–0.38)	0.30 (0.17–0.45)	0.18 (0.06–0.43)	0.12 (0.05–0.19)
Maryland	0.03 (0.00–0.12)	0.08 (0.04–0.19)	0.13 (0.06–0.22)	0.04 (0.00–0.38)	0.07 (0.03–0.15)
Massachusetts	0.04 (0.00–0.14)	0.02 (0.01–0.26)	0.11 (0.06–0.24)	0.02 (0.01–0.15)	0.06 (0.01–0.10)
Michigan	0.04 (0.00–0.08)	0.03 (0.02–0.17)	0.23 (0.10–0.34)	0.05 (0.01–0.12)	0.04 (0.01–0.11)
Missouri	0.03 (0.00–0.11)	0.03 (0.02–0.21)	0.17 (0.08–0.24)	0.13 (0.04–0.57)	0.10 (0.04–0.16)
New Jersey	0.03 (0.00–0.10)	0.14 (0.04–0.27)	0.09 (0.04–0.15)	0.04 (0.01–0.27)	0.04 (0.01–0.06)
New York	0.02 (0.00–0.05)	0.04 (0.01–0.13)	0.07 (0.03–0.12)	0.03 (0.01–0.07)	0.06 (0.03–0.09)
North Carolina	0.02 (0.00–0.09)	0.12 (0.03–0.43)	0.22 (0.17–0.35)	0.12 (0.04–0.27)	0.10 (0.07–0.18)
Ohio	0.03 (0.00–0.10)	0.03 (0.01–0.33)	0.23 (0.12–0.30)	0.03 (0.01–0.12)	0.07 (0.02–0.12)
Pennsylvania	0.03 (0.00–0.09)	0.07 (0.02–0.36)	0.17 (0.09–0.25)	0.00 (0.01–0.19)	0.05 (0.02–0.11)
Tennessee	0.01 (0.00–0.13)	0.25 (0.03–0.56)	0.18 (0.07–0.28)	0.07 (0.02–0.12)	0.14 (0.06–0.21)
Texas	0.01 (0.00–0.05)	0.13 (0.11–0.19)	0.21 (0.11–0.26)	0.02 (0.01–0.15)	0.08 (0.04–0.10)
Virginia	0.02 (0.00–0.10)	0.10 (0.03–0.32)	0.22 (0.11–0.34)	0.06 (0.02–0.10)	0.12 (0.05–0.19)
Washington	0.08 (0.01–0.17)	0.09 (0.02–0.44)	0.23 (0.11–0.35)	0.09 (0.02–0.22)	0.13 (0.06–0.22)
Wisconsin	0.12 (0.07–0.21)	0.03 (0.02–0.17)	0.07 (0.02–0.17)	0.05 (0.01–0.32)	0.02 (0.00–0.06)

NOTES: *G* is Gastwirth index. Confidence intervals (CIs) are bootstrapped 95% CIs obtained from sets of 1,000 bootstrapped replicates of the sample adult weights.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Table 2b. Composite Gastwirth indices of demographic and socioeconomic inequalities in access to medical care, percent contribution from component population attributes, and resulting state rankings among adults aged 45–64 in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Composite *G* index (95% CI)	Ranking by composite *G* index (90% most likely ranks)	Percent contribution of inequalities, by population attribute (95% CI)				
			Sex	Race and Hispanic origin	Education	Urbanicity	Disability status
Arizona	0.18 (0.12–0.28)	20 (18–20)	0.6 (0.2–14.1)	48.5 (16.2–55.4)	25.4 (11.2–41.4)	19.8 (8.3–36.4)	5.6 (0.6–15.4)
California	0.08 (0.07–0.10)	11 (4–12)	13.1 (5.5–18.6)	31.5 (20.6–38.3)	34.2 (28.5–43.1)	2.5 (0.9–14.6)	18.8 (13.9–23.3)
Florida	0.07 (0.05–0.12)	8 (2–12)	10.7 (0.8–18.7)	21.0 (9.0–48.2)	45.9 (25.3–58.0)	7.4 (2.4–22.7)	15.1 (5.9–22.7)
Georgia	0.11 (0.08–0.18)	15 (10–19)	2.8 (0.2–11.1)	15.3 (8.7–37.3)	46.0 (25.9–52.7)	8.4 (1.6–31.1)	27.4 (15.7–35.7)
Illinois	0.07 (0.06–0.12)	6 (2–12)	5.3 (0.4–19.4)	9.9 (4.2–35.1)	43.9 (26.1–52.3)	16.7 (8.1–22.6)	24.3 (13.2–30.2)
Indiana	0.16 (0.09–0.24)	19 (14–20)	4.1 (0.2–11.4)	23.9 (2.0–38.2)	35.0 (23.4–50.2)	22.3 (11.3–41.4)	14.7 (6.9–23.7)
Maryland	0.07 (0.05–0.15)	7 (2–15)	9.7 (0.6–24.4)	23.1 (9.7–42.1)	35.3 (14.1–45.3)	11.2 (1.2–48.2)	20.6 (7.1–34.0)
Massachusetts	0.05 (0.04–0.13)	2 (1–13)	18.0 (1.1–33.4)	7.7 (4.0–47.0)	42.9 (17.4–57.2)	8.4 (2.1–34.3)	23.0 (3.6–30.6)
Michigan	0.07 (0.05–0.12)	9 (2–13)	9.8 (0.3–20.0)	9.3 (4.7–35.0)	56.9 (34.1–67.1)	12.7 (3.6–28.4)	11.4 (2.5–23.2)
Missouri	0.09 (0.06–0.19)	13 (4–19)	6.9 (0.3–19.6)	6.6 (3.8–32.5)	36.7 (13.6–49.1)	27.3 (10.3–59.8)	22.6 (7.4–31.2)
New Jersey	0.07 (0.04–0.13)	5 (1–14)	10.2 (0.5–24.0)	39.9 (13.1–52.6)	27.8 (10.3–40.6)	11.1 (1.7–49.1)	11.0 (3.0–18.4)
New York	0.05 (0.03–0.07)	1 (1–3)	10.1 (0.4–22.9)	18.5 (5.1–39.6)	30.5 (14.8–47.8)	13.2 (5.2–29.2)	27.6 (11.3–39.4)
North Carolina	0.11 (0.09–0.20)	16 (12–20)	3.8 (0.2–12.9)	20.6 (4.7–43.2)	37.0 (21.7–52.7)	21.0 (7.0–32.9)	17.5 (11.2–28.3)
Ohio	0.08 (0.06–0.14)	10 (2–14)	7.3 (0.7–23.6)	8.1 (4.3–45.8)	56.6 (28.6–62.5)	9.1 (1.7–25.2)	18.9 (5.4–27.2)
Pennsylvania	0.06 (0.06–0.14)	4 (2–15)	10.1 (0.5–21.0)	21.8 (6.0–50.1)	51.5 (20.1–56.5)	1.0 (2.5–39.7)	15.6 (3.8–25.5)
Tennessee	0.13 (0.08–0.19)	17 (11–20)	1.3 (0.5–19.4)	37.5 (7.1–55.6)	27.6 (9.7–45.5)	11.3 (2.9–18.6)	22.3 (10.3–34.2)
Texas	0.09 (0.07–0.12)	12 (5–14)	3.5 (0.3–10.0)	29.4 (24.2–39.4)	44.7 (26.8–49.0)	5.0 (2.5–28.5)	17.4 (9.3–22.2)
Virginia	0.10 (0.07–0.17)	14 (4, 7–19)	4.8 (0.5–18.2)	19.1 (6.4–41.8)	40.9 (25.0–50.5)	11.2 (4.3–16.9)	24.0 (10.3–34.1)
Washington	0.13 (0.08–0.22)	18 (11–20)	13.7 (2.0–24.4)	14.5 (3.3–42.0)	35.6 (19.0–47.4)	15.1 (4.2–29.4)	21.0 (9.6–29.3)
Wisconsin	0.06 (0.04–0.14)	3 (1–9, 11–15)	39.6 (18.9–50.5)	11.2 (3.9–26.2)	24.1 (7.6–37.3)	18.1 (4.8–50.7)	6.9 (0.6–16.6)
Range	*0.05–0.18*	*1–20*	*0.6–39.6*	*6.6–48.5*	*24.1–56.9*	*1.0–27.3*	*5.6–27.6*
Not significantly ≠ 0.10 in: [1]	*18 states*	…	…	…	…	…	…
Significantly < 20% in: [2]	…	…	*11 of 19 states*	*0 of 10 states*	*0 of 0 states*	*3 of 17 states*	*3 of 11 states*
Significantly > 20% in: [3]	…	…	*0 of 1 state*	*2 of 10 states*	*11 of 20 states*	*0 of 3 states*	*0 of 9 states*

… Category not applicable.

[1]Index not significantly different from 0.10 at the 0.05 level of significance.
[2]Percent contribution to index is below the reference value of 20% and significantly different from 20% at the 0.05 level of significance for the number of states indicated.
[3]Percent contribution to index is above the reference value of 20% and significantly different from 20% at the 0.05 level of significance for the number of states indicated.

NOTES: The composite Gastwirth (*G*) index and percent contributions are calculated as described in NCHS Vital and Health Statistics Series 2, No. 180, under "Aggregating summary and composite inequalities indices." However, due to rounding, calculations using the tabulated index values may result in different values than those based on the unrounded index values. Confidence intervals (CIs) are bootstrapped 95% CIs obtained from sets of 1,000 bootstrapped replicates of the sample adult weights. Each of the 1,000 sets of bootstrapped sampling weights results in a possibly different ranking of the 20 most populous states by the composite *G* index. The 90% most likely ranks for each state are the most likely ranks that each state is assigned in 9 out of 10 bootstrapped samples.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Table 3a. Summary Gastwirth indices of inequalities among adults aged 45–64 in meeting selected criteria for general physical health status and mental health, by specified demographic and socioeconomic attributes in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Summary *G* index (95% CI)				
	Sex	Race and Hispanic origin	Education	Urbanicity	Disability status
Arizona	0.04 (0.00–0.12)	0.18 (0.03–0.41)	0.18 (0.10–0.33)	0.08 (0.01–0.23)	0.14 (0.10–0.25)
California	0.03 (0.01–0.06)	0.06 (0.04–0.09)	0.11 (0.09–0.15)	0.00 (0.00–0.06)	0.09 (0.07–0.12)
Florida	0.03 (0.01–0.07)	0.05 (0.01–0.20)	0.15 (0.11–0.20)	0.03 (0.01–0.05)	0.12 (0.09–0.16)
Georgia	0.00 (0.00–0.06)	0.22 (0.09–0.34)	0.21 (0.16–0.29)	0.08 (0.04–0.12)	0.23 (0.16–0.33)
Illinois	0.04 (0.00–0.07)	0.01 (0.01–0.16)	0.16 (0.09–0.22)	0.02 (0.01–0.13)	0.12 (0.08–0.16)
Indiana	0.10 (0.06–0.16)	0.06 (0.01–0.36)	0.21 (0.14–0.36)	0.12 (0.02–0.25)	0.10 (0.06–0.18)
Maryland	0.03 (0.00–0.08)	0.01 (0.01–0.19)	0.12 (0.06–0.18)	0.09 (0.00–0.23)	0.07 (0.02–0.13)
Massachusetts	0.08 (0.03–0.13)	0.04 (0.02–0.15)	0.11 (0.06–0.17)	0.07 (0.01–0.17)	0.07 (0.03–0.12)
Michigan	0.02 (0.00–0.07)	0.04 (0.02–0.15)	0.21 (0.16–0.30)	0.06 (0.02–0.14)	0.17 (0.12–0.24)
Missouri	0.05 (0.02–0.13)	0.04 (0.03–0.26)	0.21 (0.14–0.28)	0.28 (0.20–0.39)	0.11 (0.07–0.21)
New Jersey	0.00 (0.00–0.04)	0.05 (0.04–0.13)	0.08 (0.06–0.15)	0.03 (0.00–0.11)	0.07 (0.04–0.12)
New York	0.01 (0.00–0.04)	0.04 (0.03–0.09)	0.14 (0.09–0.20)	0.07 (0.00–0.16)	0.14 (0.10–0.20)
North Carolina	0.05 (0.00–0.09)	0.03 (0.02–0.22)	0.22 (0.18–0.29)	0.11 (0.07–0.19)	0.16 (0.12–0.25)
Ohio	0.03 (0.00–0.07)	0.03 (0.02–0.27)	0.19 (0.15–0.28)	0.06 (0.02–0.14)	0.17 (0.15–0.24)
Pennsylvania	0.03 (0.00–0.07)	0.03 (0.02–0.25)	0.16 (0.12–0.22)	0.07 (0.02–0.14)	0.15 (0.10–0.21)
Tennessee	0.02 (0.00–0.08)	0.41 (0.32–0.55)	0.24 (0.14–0.34)	0.09 (0.03–0.18)	0.21 (0.13–0.25)
Texas	0.03 (0.00–0.05)	0.09 (0.05–0.10)	0.18 (0.15–0.21)	0.03 (0.02–0.06)	0.14 (0.11–0.17)
Virginia	0.00 (0.00–0.07)	0.08 (0.02–0.30)	0.18 (0.12–0.29)	0.05 (0.01–0.13)	0.14 (0.09–0.21)
Washington	0.02 (0.00–0.06)	0.01 (0.01–0.18)	0.15 (0.09–0.20)	0.03 (0.01–0.12)	0.16 (0.07–0.22)
Wisconsin	0.02 (0.00–0.07)	0.11 (0.01–0.30)	0.07 (0.02–0.16)	0.08 (0.02–0.23)	0.06 (0.04–0.09)

NOTES: *G* is Gastwirth index. Confidence intervals (CIs) are bootstrapped 95% CIs obtained from sets of 1,000 bootstrapped replicates of the sample adult weights.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Table 3b. Composite Gastwirth indices of demographic and socioeconomic inequalities in general physical health status and mental health, percent contribution from component population attributes, and resulting state rankings among adults aged 45–64 in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Composite *G* index (95% CI)	Ranking by composite *G* index (90% most likely ranks)	Percent contribution of inequalities, by population attribute (95% CI)				
			Sex	Race and Hispanic origin	Education	Urbanicity	Disability status
Arizona	0.12 (0.09–0.21)	17 (12–20)	6.2 (0.4–16.2)	29.1 (6.2–42.7)	29.3 (15.5–41.9)	13.3 (2.5–28.0)	22.2 (14.4–37.9)
California	0.06 (0.05–0.08)	2 (1–5)	10.5 (4.0–16.6)	19.1 (13.0–25.6)	37.9 (28.3–41.7)	0.8 (0.9–17.3)	31.8 (21.9–35.2)
Florida	0.08 (0.06–0.11)	8 (1–11)	8.3 (1.4–17.8)	12.5 (2.6–36.3)	39.4 (27.1–49.5)	9.2 (1.8–12.3)	30.6 (21.7–41.1)
Georgia	0.14 (0.11–0.19)	19 (15–20)	0.4 (0.1–8.7)	29.3 (14.7–37.7)	28.2 (22.4–34.6)	11.7 (5.6–16.9)	30.5 (21.5–37.8)
Illinois	0.07 (0.06–0.11)	4 (2–11)	11.8 (0.8–19.7)	3.1 (2.7–31.0)	45.2 (21.8–49.4)	5.2 (2.7–28.8)	34.6 (20.3–37.2)
Indiana	0.12 (0.08–0.21)	16 (9–20)	17.2 (8.4–26.7)	11.1 (1.8–38.0)	34.4 (23.7–47.6)	19.7 (3.8–27.4)	17.5 (8.6–25.8)
Maryland	0.06 (0.04–0.12)	3 (1–12)	10.6 (0.2–23.6)	3.7 (4.2–42.7)	36.2 (17.9–41.5)	26.7 (1.4–45.1)	22.7 (8.0–38.0)
Massachusetts	0.07 (0.05–0.12)	7 (1–11)	22.1 (8.5–31.3)	11.5 (7.1–31.2)	29.5 (16.9–42.0)	18.3 (2.1–35.0)	18.6 (10.6–27.9)
Michigan	0.10 (0.08–0.14)	14 (8–16)	5.2 (0.2–12.0)	8.0 (4.2–23.3)	40.9 (30.1–50.2)	12.1 (3.4–23.9)	33.9 (22.2–42.7)
Missouri	0.13 (0.11–0.21)	18 (15–20)	8.4 (2.8–15.5)	5.5 (4.0–29.0)	30.4 (19.9–31.2)	39.2 (27.8–41.0)	16.4 (11.5–23.3)
New Jersey	0.05 (0.04–0.09)	1 (1–6)	0.3 (0.2–13.5)	22.3 (13.7–36.2)	34.6 (20.5–45.1)	13.1 (1.3–29.1)	29.7 (14.6–37.2)
New York	0.08 (0.06–0.11)	9 (3–13)	1.6 (0.2–10.0)	11.5 (7.3–19.6)	34.8 (22.7–43.4)	17.5 (1.5–32.8)	34.6 (24.1–43.5)
North Carolina	0.11 (0.09–0.17)	15 (11–18)	8.5 (0.3–13.3)	6.2 (3.9–27.4)	37.3 (26.3–43.2)	20.1 (12.3–26.9)	28.0 (19.0–36.2)
Ohio	0.09 (0.08–0.16)	13 (8–17)	6.1 (0.3–12.1)	6.5 (4.5–34.3)	38.6 (25.7–44.4)	13.5 (3.6–22.9)	35.2 (23.6–42.3)
Pennsylvania	0.09 (0.07–0.14)	10 (6–16)	7.8 (0.4–14.4)	7.5 (4.4–36.4)	34.9 (22.6–44.5)	16.9 (5.1–26.7)	33.0 (19.3–39.5)
Tennessee	0.19 (0.14–0.24)	20 (18–20)	2.3 (0.3–8.0)	40.4 (37.1–46.9)	25.3 (17.9–30.2)	9.8 (4.5–18.2)	22.1 (13.9–26.6)
Texas	0.09 (0.08–0.10)	12 (6–12)	6.0 (0.5–11.3)	18.6 (12.5–23.1)	37.4 (33.3–43.5)	7.4 (5.3–12.1)	30.6 (24.4–35.4)
Virginia	0.09 (0.06–0.17)	11 (5, 7–19)	0.8 (0.2–11.4)	17.6 (5.2–37.6)	39.8 (25.1–46.0)	11.5 (2.7–20.9)	30.3 (17.4–37.8)
Washington	0.07 (0.05–0.12)	6 (1–12)	6.5 (0.3–14.8)	3.2 (3.4–35.2)	39.2 (22.3–49.4)	9.4 (2.4–26.1)	41.8 (19.9–44.5)
Wisconsin	0.07 (0.04–0.14)	5 (1–14)	6.2 (0.3–20.1)	32.5 (3.1–53.4)	19.8 (5.7–36.4)	23.0 (9.4–44.7)	18.4 (7.6–35.2)
Range	*0.05–0.19*	*1–20*	*0.3–22.1*	*3.1–40.4*	*19.8–45.2*	*0.8–39.2*	*16.4–41.8*
Not significantly ≠ 0.10 in: [1]	*15 states*	…	…	…	…	…	…
Significantly < 20% in: [2]	…	…	*16 of 19 states*	*1 of 15 states*	*0 of 1 state*	*5 of 16 states*	*0 of 4 states*
Significantly > 20% in: [3]	…	…	*0 of 1 state*	*1 of 5 states*	*14 of 19 states*	*1 of 4 states*	*8 of 16 states*

… Category not applicable.

[1]Index not significantly different from 0.10 at the 0.05 level of significance.
[2]Percent contribution to index is below the reference value of 20% and significantly different from 20% at the 0.05 level of significance for the number of states indicated.
[3]Percent contribution to index is above the reference value of 20% and significantly different from 20% at the 0.05 level of significance for the number of states indicated.

NOTES: The composite Gastwirth (*G*) index and percent contributions are calculated as described in NCHS Vital and Health Statistics Series 2, No. 180, under "Aggregating summary and composite inequalities indices." However, due to rounding, calculations using the tabulated index values may result in different values than those based on the unrounded index values. Confidence intervals (CIs) are bootstrapped 95% CIs obtained from sets of 1,000 bootstrapped replicates of the sample adult weights. Each of the 1,000 sets of bootstrapped sampling weights results in a possibly different ranking of the 20 most populous states by the composite *G* index. The 90% most likely ranks for each state are the most likely ranks that each state is assigned in 9 out of 10 bootstrapped samples.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Table 4a. Summary Gastwirth indices of inequalities among adults aged 45–64 in meeting selected criteria for absence of multiple chronic conditions, by specified demographic and socioeconomic attributes in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Summary *G* index (95% CI)				
	Sex	Race and Hispanic origin	Education	Urbanicity	Disability status
Arizona	0.03 (0.00–0.15)	0.03 (0.02–0.31)	0.15 (0.08–0.29)	0.06 (0.03–0.14)	0.11 (0.07–0.22)
California	0.02 (0.00–0.05)	0.06 (0.03–0.12)	0.07 (0.04–0.10)	0.02 (0.01–0.04)	0.08 (0.06–0.10)
Florida	0.00 (0.00–0.04)	0.09 (0.04–0.24)	0.15 (0.11–0.20)	0.04 (0.02–0.07)	0.10 (0.07–0.14)
Georgia	0.07 (0.00–0.14)	0.27 (0.08–0.45)	0.21 (0.13–0.28)	0.12 (0.06–0.19)	0.19 (0.13–0.25)
Illinois	0.02 (0.00–0.07)	0.19 (0.06–0.30)	0.14 (0.08–0.23)	0.02 (0.01–0.13)	0.14 (0.09–0.18)
Indiana	0.06 (0.01–0.13)	0.02 (0.02–0.57)	0.20 (0.08–0.33)	0.04 (0.01–0.28)	0.08 (0.02–0.17)
Maryland	0.12 (0.03–0.18)	0.18 (0.03–0.33)	0.14 (0.06–0.24)	0.06 (0.01–0.35)	0.08 (0.02–0.14)
Massachusetts	0.02 (0.00–0.10)	0.09 (0.02–0.34)	0.13 (0.07–0.20)	0.12 (0.02–0.25)	0.09 (0.05–0.14)
Michigan	0.02 (0.00–0.07)	0.02 (0.01–0.19)	0.17 (0.07–0.28)	0.04 (0.01–0.14)	0.12 (0.07–0.18)
Missouri	0.00 (0.00–0.12)	0.09 (0.03–0.51)	0.19 (0.10–0.30)	0.06 (0.05–0.55)	0.07 (0.03–0.15)
New Jersey	0.06 (0.01–0.10)	0.20 (0.09–0.26)	0.06 (0.04–0.14)	0.00 (0.00–0.27)	0.07 (0.04–0.11)
New York	0.03 (0.00–0.06)	0.01 (0.01–0.12)	0.12 (0.09–0.19)	0.03 (0.01–0.05)	0.09 (0.05–0.13)
North Carolina	0.02 (0.00–0.08)	0.10 (0.03–0.32)	0.20 (0.10–0.32)	0.10 (0.05–0.20)	0.12 (0.07–0.19)
Ohio	0.04 (0.00–0.12)	0.11 (0.02–0.44)	0.14 (0.06–0.22)	0.13 (0.05–0.21)	0.15 (0.11–0.22)
Pennsylvania	0.04 (0.00–0.09)	0.25 (0.02–0.46)	0.11 (0.04–0.16)	0.03 (0.02–0.12)	0.13 (0.07–0.19)
Tennessee	0.04 (0.00–0.15)	0.38 (0.05–0.77)	0.17 (0.09–0.27)	0.05 (0.01–0.14)	0.17 (0.07–0.21)
Texas	0.02 (0.00–0.05)	0.04 (0.02–0.16)	0.09 (0.05–0.14)	0.04 (0.01–0.07)	0.11 (0.08–0.14)
Virginia	0.00 (0.00–0.07)	0.21 (0.09–0.39)	0.10 (0.06–0.21)	0.04 (0.01–0.09)	0.11 (0.07–0.18)
Washington	0.06 (0.01–0.13)	0.10 (0.05–0.41)	0.16 (0.08–0.25)	0.05 (0.01–0.15)	0.17 (0.07–0.29)
Wisconsin	0.03 (0.00–0.10)	0.26 (0.10–0.43)	0.06 (0.03–0.18)	0.03 (0.01–0.26)	0.06 (0.03–0.10)

NOTES: *G* is Gastwirth index. Confidence intervals (CIs) are bootstrapped 95% CIs obtained from sets of 1,000 bootstrapped replicates of the sample adult weights.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Table 4b. Composite Gastwirth indices of demographic and socioeconomic inequalities in absence of multiple chronic conditions, percent contribution from component population attributes, and resulting state rankings among adults aged 45–64 in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Composite *G* index (95% CI)	Ranking by composite *G* index (90% most likely ranks)	Percent contribution of inequalities, by population attribute (95% CI)				
			Sex	Race and Hispanic origin	Education	Urbanicity	Disability status
Arizona	0.08 (0.07–0.16)	6 (5–17)	8.4 (0.9–24.3)	8.6 (4.0–41.2)	38.9 (16.0–46.8)	16.1 (5.5–26.9)	28.1 (13.5–36.9)
California	0.05 (0.04–0.07)	1 (1–3)	6.6 (1.0–17.5)	23.9 (14.0–38.4)	30.4 (16.7–35.4)	7.0 (3.2–15.0)	32.2 (21.2–38.5)
Florida	0.08 (0.06–0.11)	5 (3–10)	0.3 (0.1–10.7)	23.5 (11.1–42.9)	39.0 (24.6–47.0)	11.0 (4.7–16.0)	26.2 (18.5–32.2)
Georgia	0.17 (0.11–0.22)	20 (15–20)	8.1 (0.3–15.8)	30.5 (12.3–43.6)	24.6 (17.6–35.6)	14.7 (8.3–23.2)	22.1 (16.4–30.4)
Illinois	0.10 (0.08–0.14)	13 (6–16)	4.8 (0.3–14.2)	36.9 (14.6–47.0)	27.2 (16.4–40.0)	4.4 (1.4–22.3)	26.8 (18.5–34.0)
Indiana	0.08 (0.05–0.23)	8 (2–5, 7, 9–20)	15.9 (1.2–23.9)	4.8 (3.3–55.2)	47.7 (16.4–54.0)	11.1 (2.5–31.8)	20.6 (5.4–26.3)
Maryland	0.12 (0.07–0.19)	18 (6, 8–20)	20.7 (7.0–32.1)	30.2 (6.1–45.0)	23.3 (11.9–40.7)	11.5 (1.3–42.2)	14.3 (4.9–23.0)
Massachusetts	0.09 (0.05–0.15)	11 (2–16)	4.1 (0.3–21.1)	20.6 (4.9–46.7)	28.8 (14.4–43.6)	26.1 (4.5–39.9)	20.5 (10.2–32.4)
Michigan	0.07 (0.06–0.12)	4 (2–11)	6.0 (0.3–17.4)	5.3 (3.2–35.0)	45.4 (18.4–56.5)	12.1 (2.2–30.5)	31.3 (17.1–45.5)
Missouri	0.08 (0.08–0.25)	9 (9–20)	0.3 (0.3–15.2)	21.8 (7.7–54.3)	44.3 (12.5–46.3)	15.7 (8.3–49.5)	17.9 (5.1–20.5)
New Jersey	0.08 (0.06–0.14)	7 (3–15)	15.7 (3.5–21.4)	50.0 (23.7–52.9)	15.3 (8.9–30.4)	0.3 (0.8–40.1)	18.6 (9.0–25.5)
New York	0.05 (0.05–0.09)	2 (1–5)	10.5 (0.4–17.5)	4.5 (3.5–30.0)	42.6 (29.8–51.4)	11.3 (4.5–17.8)	31.1 (17.3–38.3)
North Carolina	0.11 (0.07–0.18)	15 (6–19)	3.7 (0.3–12.9)	19.4 (6.8–38.5)	36.5 (23.1–43.6)	18.5 (10.3–31.4)	22.0 (13.2–32.3)
Ohio	0.11 (0.08–0.19)	17 (7–19)	6.8 (0.7–19.5)	19.2 (4.3–46.6)	24.6 (10.0–35.0)	23.2 (7.9–34.2)	26.2 (16.0–38.9)
Pennsylvania	0.11 (0.07–0.15)	16 (5–17)	6.7 (0.6–17.5)	43.3 (5.9–57.3)	20.1 (8.2–34.3)	6.2 (3.4–21.6)	23.6 (13.4–41.1)
Tennessee	0.16 (0.09–0.24)	19 (12–20)	4.9 (0.4–18.0)	44.8 (13.5–61.5)	21.8 (12.0–35.3)	7.0 (2.4–15.5)	21.5 (8.6–32.4)
Texas	0.06 (0.05–0.09)	3 (1–5)	7.1 (0.2–13.7)	13.3 (8.5–38.6)	29.6 (15.6–37.8)	13.5 (3.4–22.2)	36.5 (21.6–45.3)
Virginia	0.09 (0.06–0.15)	12 (4–17)	0.0 (0.2–14.2)	43.1 (23.5–55.8)	22.7 (14.2–34.0)	9.7 (1.6–14.5)	24.5 (14.1–31.6)
Washington	0.11 (0.08–0.20)	14 (7, 9–20)	11.1 (1.6–19.3)	19.1 (11.9–48.9)	29.9 (15.4–35.5)	8.7 (2.4–21.0)	31.2 (13.5–35.6)
Wisconsin	0.09 (0.07–0.16)	10 (5–18)	7.5 (0.5–16.8)	56.8 (24.1–64.9)	13.2 (6.1–32.1)	7.9 (1.9–35.5)	14.7 (5.6–20.8)
Range	*0.05–0.17*	*1–20*	*0.0–20.7*	*4.5–56.8*	*13.2–47.7*	*0.3–26.1*	*14.3–36.5*
Not significantly ≠ 0.10 in: [1]	*16 states*	…	…	…	…	…	…
Significantly < 20% in: [2]	…	…	*15 of 19 states*	*0 of 8 states*	*0 of 2 states*	*5 of 18 states*	*0 of 4 states*
Significantly > 20% in: [3]	…	…	*0 of 1 state*	*3 of 12 states*	*3 of 18 states*	*0 of 2 states*	*2 of 16 states*

… Category not applicable.

[1]Index not significantly different from 0.10 at the 0.05 level of significance.
[2]Percent contribution to index is below the reference value of 20% and significantly different from 20% at the 0.05 level of significance for the number of states indicated.
[3]Percent contribution to index is above the reference value of 20% and significantly different from 20% at the 0.05 level of significance for the number of states indicated.

NOTES: The composite Gastwirth (*G*) index and percent contributions are calculated as described in NCHS Vital and Health Statistics Series 2, No. 180, under "Aggregating summary and composite inequalities indices." However, due to rounding, calculations using the tabulated index values may result in different values than those based on the unrounded index values. Confidence intervals (CIs) are bootstrapped 95% CIs obtained from sets of 1,000 bootstrapped replicates of the sample adult weights. Additionally, each one of the 1,000 sets of bootstrapped sampling weights results in a possibly different ranking of the 20 most populous states by the composite *G* index. The 90% most likely ranks for each state are the most likely ranks that each state is assigned in 9 out of 10 bootstrapped samples.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Table 5. Overall Gastwirth index of demographic and socioeconomic inequalities in selected core measures of health, percent contribution from component health measures and population attributes, and resulting state rankings among adults aged 45–64 in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Overall *G* index (95% CI)	Ranking by overall *G* index (90% most likely ranks)	Percent contribution of inequalities, in selected health measure (95% CI)			
			Healthy behaviors	Access to medical care	General physical health status and mental health	Absence of multiple chronic conditions
Arizona	0.14 (0.13–0.26)	14 (11–20)	33.7 (27.5–50.5)	31.2 (17.9–35.3)	21.5 (14.1–25.6)	13.6 (10.1–21.5)
California	0.09 (0.09–0.12)	3 (1–5)	49.3 (43.5–58.4)	21.5 (16.3–24.7)	16.1 (12.6–19.9)	13.0 (9.8–16.5)
Florida	0.11 (0.09–0.15)	6 (1–9)	48.2 (35.8–57.8)	17.0 (11.6–25.5)	17.4 (12.6–22.9)	17.4 (13.7–23.0)
Georgia	0.19 (0.16–0.25)	18 (14–20)	42.4 (34.1–52.1)	15.0 (11.3–21.9)	19.6 (15.4–24.6)	22.9 (16.2–25.7)
Illinois	0.09 (0.09–0.15)	4 (1–8)	35.3 (33.0–51.4)	19.5 (12.5–23.8)	18.2 (13.4–22.9)	27.0 (17.5–29.0)
Indiana	0.19 (0.14–0.28)	19 (13–20)	52.1 (32.1–63.8)	21.3 (12.3–29.5)	15.9 (10.8–23.1)	10.7 (7.4–24.6)
Maryland	0.11 (0.10–0.17)	5 (2–12)	39.9 (28.8–57.6)	17.5 (11.4–26.4)	15.3 (9.2–23.0)	27.2 (15.1–33.0)
Massachusetts	0.08 (0.08–0.16)	1 (1–10)	37.5 (29.2–60.3)	14.9 (9.7–26.7)	21.5 (11.2–24.5)	26.1 (13.3–30.6)
Michigan	0.13 (0.11–0.19)	11 (5–16)	52.0 (41.6–63.2)	14.7 (8.6–19.8)	18.8 (13.6–23.8)	14.4 (9.5–20.9)
Missouri	0.13 (0.13–0.25)	13 (11–20)	41.8 (29.7–56.4)	17.4 (8.6–23.4)	25.1 (16.0–27.9)	15.7 (14.1–27.4)
New Jersey	0.09 (0.08–0.16)	2 (1–8, 10)	44.5 (32.1–60.5)	19.5 (10.0–29.2)	13.7 (9.4–19.7)	22.3 (13.6–29.7)
New York	0.12 (0.11–0.16)	10 (4–12)	62.2 (50.6–68.7)	9.9 (5.6–14.5)	16.2 (12.8–21.4)	11.7 (9.1–17.9)
North Carolina	0.15 (0.13–0.23)	15 (9–19)	41.9 (33.6–51.8)	19.7 (14.3–27.5)	19.8 (14.6–24.7)	18.6 (12.9–24.0)
Ohio	0.16 (0.14–0.23)	17 (12–20)	54.1 (40.1–64.4)	12.5 (8.1–18.9)	15.4 (11.3–22.4)	18.0 (11.7–24.9)
Pennsylvania	0.15 (0.12–0.22)	16 (6–18)	56.1 (41.0–61.5)	10.7 (9.3–21.1)	14.8 (11.5–21.9)	18.5 (11.9–23.8)
Tennessee	0.20 (0.17–0.28)	20 (16–20)	40.8 (29.1–56.2)	16.1 (10.6–20.8)	23.3 (16.0–28.0)	19.8 (11.3–27.8)
Texas	0.13 (0.12–0.15)	12 (5–11)	53.2 (47.6–57.4)	17.4 (14.1–21.5)	18.1 (14.8–19.7)	11.4 (9.3–16.6)
Virginia	0.12 (0.10–0.23)	8 (3, 5–19)	39.0 (32.0–55.2)	22.0 (13.6–24.6)	19.2 (13.6–24.8)	19.9 (12.9–24.0)
Washington	0.11 (0.10–0.20)	7 (3–16)	32.5 (23.8–53.7)	27.6 (15.9–31.9)	16.2 (10.5–19.7)	23.6 (14.8–31.5)
Wisconsin	0.12 (0.10–0.22)	9 (3–18)	53.5 (35.9–65.0)	12.9 (7.7–23.7)	14.8 (8.4–21.8)	18.7 (11.3–28.6)
Range	*0.08–0.20*	*1–20*	*32.5–62.2*	*9.9–31.2*	*13.7–25.1*	*10.7–27.2*
Not significantly ≠ 0.10 in: [1]	*9 states*	…	…	…	…	…
Significantly < 25% in: [2]	…	…	*0 of 0 states*	*12 of 18 states*	*17 of 19 states*	*11 of 17 states*
Significantly > 25% in: [3]	…	…	*19 of 20 states*	*0 of 2 states*	*0 of 1 state*	*0 of 3 states*

See footnotes at end of table.

Table 5. Overall Gastwirth index of demographic and socioeconomic inequalities in selected core measures of health, percent contribution from component health measures and population attributes, and resulting state rankings among adults aged 45–64 in the 20 most populous states: National Health Interview Survey, 2013–2015—Con.

State	Percent contribution of inequalities, in selected health measure (95% CI)				
	Sex	Race and Hispanic origin	Education	Urbanicity	Disability status
Arizona	5.0 (2.9–15.8)	28.4 (16.4–39.1)	33.3 (19.3–38.9)	18.1 (11.5–31.6)	15.2 (10.2–21.4)
California	7.6 (4.5–13.2)	27.6 (21.3–35.3)	38.5 (29.7–40.5)	6.6 (4.0–17.2)	19.7 (14.6–21.9)
Florida	5.9 (3.0–12.2)	20.6 (15.0–37.9)	39.5 (27.6–44.2)	15.5 (5.8–25.5)	18.4 (13.5–23.0)
Georgia	9.8 (3.7–15.2)	22.0 (14.6–32.2)	31.8 (25.2–36.4)	15.9 (11.7–26.0)	20.5 (16.0–26.6)
Illinois	6.2 (2.4–13.0)	23.9 (13.4–33.1)	39.9 (27.9–45.1)	7.1 (5.7–22.2)	22.8 (15.8–27.7)
Indiana	15.3 (8.6–18.5)	26.3 (10.4–43.4)	28.3 (20.7–39.4)	16.5 (11.0–27.6)	13.6 (7.4–18.1)
Maryland	18.2 (7.1–25.3)	25.4 (13.1–36.7)	29.4 (18.8–38.3)	11.5 (5.4–33.1)	15.5 (8.0–20.7)
Massachusetts	8.9 (4.0–18.2)	15.3 (8.0–38.4)	36.3 (20.3–41.5)	22.7 (9.9–31.0)	16.8 (9.6–29.5)
Michigan	7.2 (2.7–12.4)	16.3 (10.6–28.9)	42.9 (27.3–48.7)	15.5 (8.3–27.3)	18.2 (12.0–25.8)
Missouri	9.2 (3.2–16.0)	12.3 (8.2–36.0)	37.8 (18.6–38.7)	23.0 (16.7–44.0)	17.7 (8.1–19.7)
New Jersey	13.1 (6.1–16.2)	40.9 (22.9–44.5)	27.6 (18.0–33.3)	4.3 (4.9–31.5)	14.1 (7.7–19.4)
New York	10.0 (3.3–13.7)	9.9 (9.0–21.5)	34.6 (26.9–40.3)	25.5 (14.8–34.4)	20.0 (12.9–24.7)
North Carolina	3.4 (1.9–10.0)	14.6 (8.5–32.3)	40.5 (29.2–45.5)	21.3 (13.7–26.8)	20.2 (14.8–24.7)
Ohio	5.4 (2.5–11.8)	22.8 (10.8–40.8)	38.2 (25.0–42.6)	14.4 (6.9–23.2)	19.1 (12.9–24.1)
Pennsylvania	7.2 (3.7–12.5)	35.3 (10.2–46.7)	33.4 (22.5–42.3)	6.0 (7.4–20.2)	18.1 (10.9–26.0)
Tennessee	6.2 (3.6–13.6)	35.7 (25.8–47.9)	27.6 (18.6–31.7)	11.5 (7.5–19.5)	19.0 (10.6–20.8)
Texas	8.2 (4.1–11.7)	19.1 (16.6–28.5)	40.2 (33.0–43.1)	10.6 (8.1–16.4)	22.0 (16.3–24.9)
Virginia	6.2 (3.5–13.8)	26.3 (18.1–43.6)	33.5 (23.1–37.5)	10.5 (5.9–16.9)	23.4 (13.1–25.5)
Washington	10.6 (4.6–15.1)	17.4 (15.3–40.7)	36.4 (22.0–39.2)	9.3 (6.4–20.4)	26.3 (12.5–28.1)
Wisconsin	12.1 (7.5–17.5)	35.8 (18.3–44.2)	20.2 (12.9–30.2)	21.9 (13.4–37.4)	10.1 (6.0–14.8)
Range	*3.4–18.2*	*9.9–40.9*	*20.2–42.9*	*4.3–25.5*	*10.1–26.3*
Not significantly ≠ 0.10 in: [1]	…	…	…	…	…
Significantly < 20% in: [2]	*19 of 20 states*	*0 of 8 states*	*0 of 0 states*	*4 of 15 states*	*4 of 14 states*
Significantly > 20% in: [3]	*0 of 0 states*	*3 of 12 states*	*14 of 20 states*	*0 of 5 states*	*0 of 6 states*

… Category not applicable.

[1]Index not significantly different from 0.10 at the 0.05 level of significance.
[2]Percent contribution to index is below the reference value of 25% or 20% and significantly different from the reference value at the 0.05 level of significance for the number of states indicated.
[3]Percent contribution to index is above the reference value of 25% or 20% and significantly different from the reference value at the 0.05 level of significance for the number of states indicated.

NOTES: The overall Gastwirth (*G*) index and percent contributions are calculated as described in NCHS Vital and Health Statistics Series 2, No. 180, under "Aggregating summary and composite inequalities indices." However, due to rounding, calculations using the tabulated index values may result in different values than those based on the unrounded index values. Confidence intervals (CIs) are bootstrapped 95% CIs obtained from sets of 1,000 bootstrapped replicates of the sample adult weights. Additionally, each one of the 1,000 sets of bootstrapped sampling weights results in a possibly different ranking of the 20 most populous states by the composite *G* index. The 90% most likely ranks for each state are the most likely ranks that each state is assigned in 9 out of 10 bootstrapped samples.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Table 6. Rankings from the overall Gastwirth and Atkinson unadjusted and adjusted indices in the 20 most populous states: National Health Interview Survey, 2013–2015

State	Ranking (90% most likely ranks)						
	Overall *G* index	Overall A_α index, $\alpha = 0.5$	Adjusted overall A_α index, $\alpha = 0.5$	Overall A_α index, $\alpha = 1$	Adjusted overall A_α index, $\alpha = 1$	Overall A_α index, $\alpha = 2$	Adjusted overall A_α index, $\alpha = 2$
Massachusetts	1 (1–10)	10 (1–14)	4 (1–10)	16 (1–10, 16.5–18.5)	8 (1–7, 16.5–18.5)	20 (2–12, 16.5–18.5)	19 (1–9, 16.5–18.5)
New Jersey	2 (1–8, 10)	1 (1–10)	2 (1–9)	2 (1–7, 10, 16.5–18.5)	2 (1–5, 16.5–18.5)	2 (1–8, 10, 16.5–18.5)	1 (1–7, 16.5–18.5)
California	3 (1–5)	6 (1–5)	8 (7–14)	6 (1–5)	6 (2–8)	3 (1–4)	6 (1–6)
Illinois	4 (1–8)	8 (1–11)	10 (8–17)	8 (2–11)	9 (4–12)	8 (2–11)	9 (3–11)
Maryland	5 (2–12)	5 (1–14)	3 (1–13)	4 (1–12, 16.5–18)	3 (1–9, 16.5–18)	4 (1–14, 16.5–18)	3 (1–12, 16.5–18)
Florida	6 (1–9)	4 (1–7)	5 (4–10)	5 (1–6)	4 (1–5)	5 (1–7)	5 (1–6)
Washington	7 (3–16)	9 (4–16)	7 (1–4, 7–14)	11 (5–12, 16.5–19)	12 (4–11, 16.5–19)	19 (8–14, 16–18.5)	20 (9–18.5)
Virginia	8 (3, 5–19)	12 (6–11, 13–20)	11 (3–16)	12 (5–14, 16.5–19)	10 (3–12, 16.5–19)	13 (6–14, 16–19)	10 (3, 5–13, 16–19)
Wisconsin	9 (3–18)	3 (1–9, 11–17)	1 (1–7)	3 (1–5, 16.5–19)	1 (1–3, 16.5–18.5)	6 (1–5, 16.5–19)	2 (1–3, 16.5–19)
New York	10 (4–12)	7 (2–12)	9 (10–19)	7 (2–11)	7 (4–13)	7 (1–10)	7 (3–12)
Michigan	11 (5–16)	2 (1–9)	6 (6–15)	1 (1–8)	5 (1–8)	1 (1–7)	4 (1–7)
Texas	12 (5–11)	18 (10–17)	19 (16–20)	18 (8–14)	19 (9–15)	15 (7–14)	16 (8–15)
Missouri	13 (11–20)	19 (15–20)	12 (2–14)	19 (13, 15–19)	13 (8, 10–11, 13, 16–19)	17 (14, 16–19)	14 (13–19)
Arizona	14 (11–20)	13 (10–20)	13 (3–5, 11–20)	15 (8–18)	17 (7–18)	14 (8–18)	17 (8–18)
North Carolina	15 (9–19)	17 (8, 10–19)	17 (13–20)	17 (8–16)	18 (7–16)	16 (8–16)	15 (7–16)
Pennsylvania	16 (6–18)	14 (7–16)	18 (13–20)	10 (5–13)	16 (6–14)	10 (4–13)	13 (6–14)
Ohio	17 (12–20)	11 (7–18)	14 (2–6, 11–19)	9 (5–15, 16.5–18)	11 (5–14, 16.5–18)	9 (4–14, 16.5–18)	8 (4–14, 16.5–18)
Georgia	18 (14–20)	20 (14–20)	20 (4–9, 15–20)	20 (11–18)	20 (10–18)	18 (10–18)	18 (10–18)
Indiana	19 (13–20)	15 (6–20)	15 (1–16, 20)	14 (5–14, 16–19)	15 (5–14, 16–19)	12 (5–6, 8–19)	12 (2, 6–14, 16–19)
Tennessee	20 (16–20)	16 (8–20)	16 (1–8, 15–20)	13 (7–13, 16–19)	14 (8, 10–18.5)	11 (4–10, 16.5–19)	11 (7–14, 16.5–19)

NOTES: *G* is Gastwirth index. The summary Atkinson indices are given by $A_\alpha = 1 - (p_{tot}^{(\alpha)}/p_{tot})$, where p_{tot} is the population-weighted arithmetic average of the subgroup percentages, and $p_{tot}^{(\alpha)}$ is a generalized population-weighted geometric average that, as α increases, gives more weight to those subgroups having less favorable percentages. Summary adjusted Atkinson indices are obtained from the summary Atkinson indices A_α—prior to aggregating to the composite and overall indices—by scaling them by the factor $1/A_\infty$, where $A_\infty = 1 - p_{min}/p_{tot}$, and p_{min} is the least favorable subgroup percentage. The summary, composite, and overall Atkinson indices are not tabulated in this report. Each of the 1,000 sets of bootstrapped sampling weights results in a possibly different ranking of the 20 most populous states by the overall index selected. The 90% most likely ranks for each state are the most likely ranks that each state is assigned in 9 out of 10 bootstrapped samples. Fractional ranks may occur in tiebreaking.

SOURCE: NCHS, National Health Interview Survey, 2013–2015.

Appendix. Comparing National Health Interview Survey-sourced Health Measures With Those for Institute of Medicine's *Vital Signs*

Table. Crosswalk between National Health Interview Survey-sourced core health measures constructed for NCHS Vital and Health Statistics Series 2, No. 180, and Institute of Medicine's *Vital Signs* measures

NHIS-sourced core health measure	NHIS-sourced indicator	NHIS indicator case definition		*Vital Signs* Core Metrics Domain—Key Element—Focus—Core or Related Priority Measure
Healthy behaviors	Percentage of adults meeting selected criteria of healthy behavior	Person meets all three† of the following criteria: 1) nonsmoker; 2) nonheavy drinker; 3) meets physical activity guidelines	1. Smoker is defined as a cur ent smoker (every day or some days)	Healthy people—healthy behaviors—addictive behaviors—**related priority measure**: *tobacco use*
		† *Only first two criteria are used if person is unable to engage in specified physical activity*	2. Heavy drinker is defined as a current heavy drinker (12 or more drinks in lifetime, 12 or more drinks in past year, and either 15 or more drinks per week for males or 8 or more drinks per week for females in past year)	Healthy people—healthy behaviors—addictive behaviors—**related priority measure**: *alcohol dependence/misuse*
			3. Does not meet physical activity guidelines (if person is reported to be able to do the physical activity in question)	Healthy people—healthy behaviors—overweight and obesity—**related priority measure**: *activity levels*
Access to medical care	Percentage of adults with access to medical care	Person has: 1) a usual place of care; 2) no unmet medical needs due to cost; 3) no general delay in getting medical care	1. Person reports a usual place of care other than the emergency room	Care quality—access to care—care access—**related priority measure**: *usual source of care*
			2. Person reports no unmet general medical care need or delayed medical care due to cost	Care quality—access to care—care access—**core measure**: *unmet care need*
			3. Person reports no general delay in medical care due to problems in reaching a medical office	Care quality—access to care—care access—**related priority measure**: *delay of needed care*
General physical health status and mental health	Percentage of adults meeting selected criteria of general physical health status and mental health	Person meets all of the following criteria: 1) Self-assessed general health is "good" or better; 2) he or she does not present serious, moderate, or mild nonspecific psychological distress (NSPD)	1. Person reports that his or her general physical health is excellent, very good, or good	Healthy people—quality of life—well-being—**core measure**: *self-reported health*
			2. Person has a total score of 0–7 on the Kessler K6 NSPD scale, indicating either absence of or less than mild NSPD	Healthy people—quality of life—well-being—**related priority measure**: *depression*
Absence of multiple chronic conditions	Percentage of adults who have at most 1 of 10 selected chronic conditions	Person has at most 1 of these 10 chronic conditions: cancer (excluding skin non-melanoma cases); hypertension; coronary heart disease; stroke; COPD (including emphysema and chronic bronchitis); asthma; diabetes (excluding gestational diabetes); arthritis (including rheumatoid arthritis, gout, lupus, or fib omyalgia); hepatitis; weak or failing kidneys (excluding kidney stones, bladder infections, or incontinence)		Healthy people—quality of life—well-being—**related priority measure**: *multiple chronic conditions*

NOTE: NCHS is National Center for Health Statistics; NHIS is National Health Interview Survey; and COPD is chronic obstructive pulmonary disease.

SOURCES: NCHS, National Health Interview Survey, 2013–2015; Institute of Medicine, *Vital Signs: Core Metrics for Health and Health Care Progress*, 2015.

Vital and Health Statistics Series Descriptions

Active Series

Series 1. **Programs and Collection Procedures**
Reports describe the programs and data systems of the National Center for Health Statistics, and the data collection and survey methods used. Series 1 reports also include definitions, survey design, estimation, and other material necessary for understanding and analyzing the data.

Series 2. **Data Evaluation and Methods Research**
Reports present new statistical methodology including experimental tests of new survey methods, studies of vital and health statistics collection methods, new analytical techniques, objective evaluations of reliability of collected data, and contributions to statistical theory. Reports also include comparison of U.S. methodology with those of other countries.

Series 3. **Analytical and Epidemiological Studies**
Reports present data analyses, epidemiological studies, and descriptive statistics based on national surveys and data systems. As of 2015, Series 3 includes reports that would have previously been published in Series 5, 10–15, and 20–23.

Discontinued Series

Series 4. **Documents and Committee Reports**
Reports contain findings of major committees concerned with vital and health statistics and documents. The last Series 4 report was published in 2002; these are now included in Series 2 or another appropriate series.

Series 5. **International Vital and Health Statistics Reports**
Reports present analytical and descriptive comparisons of U.S. vital and health statistics with those of other countries. The last Series 5 report was published in 2003; these are now included in Series 3 or another appropriate series.

Series 6. **Cognition and Survey Measurement**
Reports use methods of cognitive science to design, evaluate, and test survey instruments. The last Series 6 report was published in 1999; these are now included in Series 2.

Series 10. **Data From the National Health Interview Survey**
Reports present statistics on illness; accidental injuries; disability; use of hospital, medical, dental, and other services; and other health-related topics. As of 2015, these are included in Series 3.

Series 11. **Data From the National Health Examination Survey, the National Health and Nutrition Examination Surveys, and the Hispanic Health and Nutrition Examination Survey**
Reports present 1) estimates of the medically defined prevalence of specific diseases in the United States and the distribution of the population with respect to physical, physiological, and psychological characteristics and 2) analysis of relationships among the various measurements. As of 2015, these are included in Series 3.

Series 12. **Data From the Institutionalized Population Surveys**
The last Series 12 report was published in 1974; these reports were included in Series 13, and as of 2015 are in Series 3.

Series 13. **Data From the National Health Care Survey**
Reports present statistics on health resources and use of health care resources based on data collected from health care providers and provider records. As of 2015, these reports are included in Series 3.

Series 14. **Data on Health Resources: Manpower and Facilities**
The last Series 14 report was published in 1989; these reports were included in Series 13, and are now included in Series 3.

Series 15. **Data From Special Surveys**
Reports contain statistics on health and health-related topics from surveys that are not a part of the continuing data systems of the National Center for Health Statistics. The last Series 15 report was published in 2002; these reports are now included in Series 3.

Series 16. **Compilations of Advance Data From Vital and Health Statistics**
The last Series 16 report was published in 1996. All reports are available online; compilations are no longer needed.

Series 20. **Data on Mortality**
Reports include analyses by cause of death and demographic variables, and geographic and trend analyses. The last Series 20 report was published in 2007; these reports are now included in Series 3.

Series 21. **Data on Natality, Marriage, and Divorce**
Reports include analyses by health and demographic variables, and geographic and trend analyses. The last Series 21 report was published in 2006; these reports are now included in Series 3.

Series 22. **Data From the National Mortality and Natality Surveys**
The last Series 22 report was published in 1973. Reports from sample surveys of vital records were included in Series 20 or 21, and are now included in Series 3.

Series 23. **Data From the National Survey of Family Growth**
Reports contain statistics on factors that affect birth rates, factors affecting the formation and dissolution of families, and behavior related to the risk of HIV and other sexually transmitted diseases. The last Series 23 report was published in 2011; these reports are now included in Series 3.

Series 24. **Compilations of Data on Natality, Mortality, Marriage, and Divorce**
The last Series 24 report was published in 1996. All reports are available online; compilations are no longer needed.

For answers to questions about this report or for a list of reports published in these series, contact:

Information Dissemination Staff
National Center for Health Statistics
Centers for Disease Control and Prevention
3311 Toledo Road, Room 4551, MS P08
Hyattsville, MD 20782

Tel: 1–800–CDC–INFO (1–800–232–4636)
TTY: 1–888–232–6348
Internet: https://www.cdc.gov/nchs
Online request form: https://www.cdc.gov/info
For e-mail updates on NCHS publication releases, subscribe online at: https://www.cdc.gov/nchs/govdelivery.htm.

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES

Centers for Disease Control and Prevention
National Center for Health Statistics
3311 Toledo Road, Room 4551, MS P08
Hyattsville, MD 20782–2064

For more NCHS Series Reports, visit:
https://www.cdc.gov/nchs/products/series.htm

DHHS Publication No. (PHS) 2018–1378, Series 2, No. 180
CS291054